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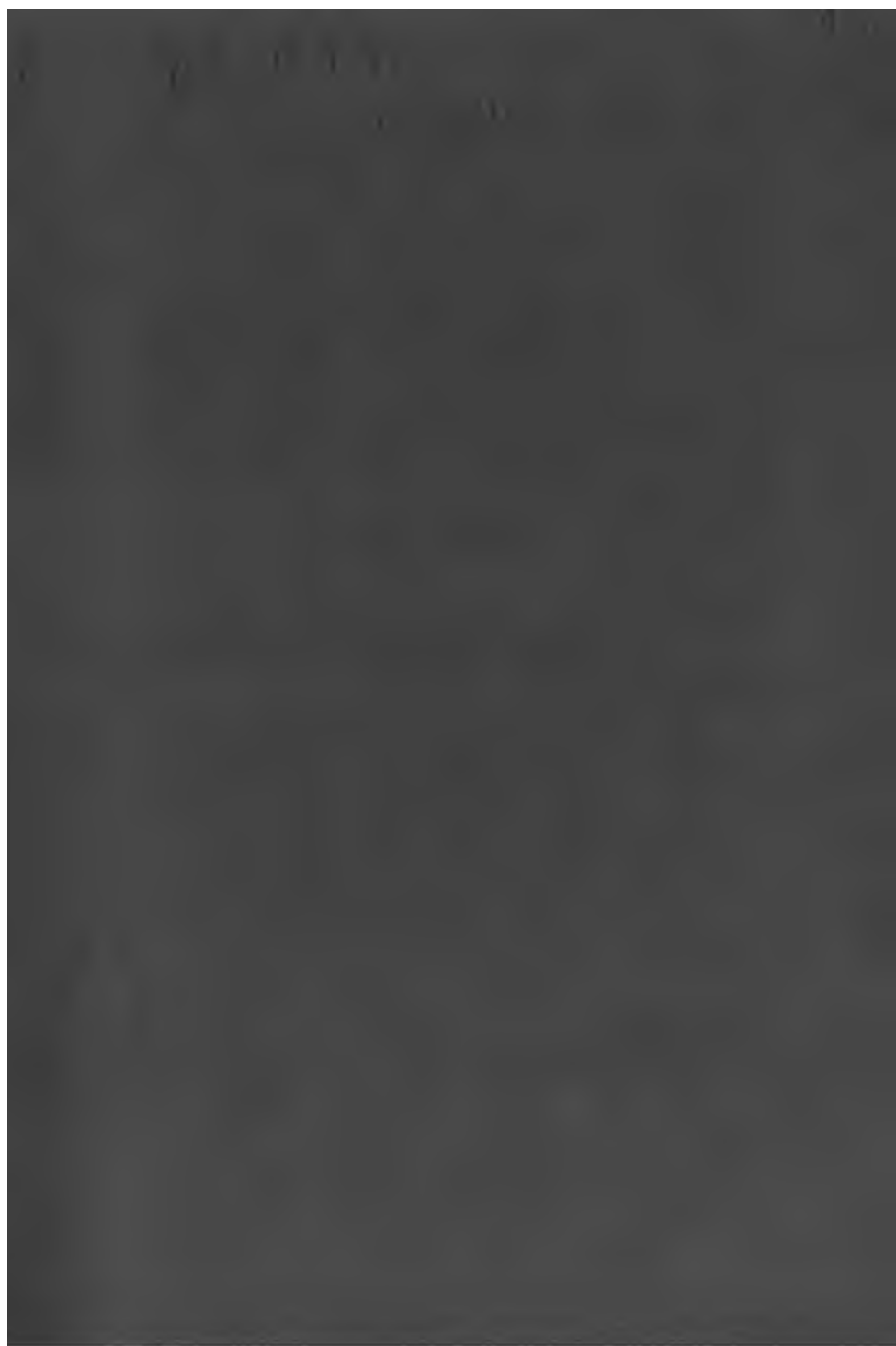
GEOLOGIST'S
TRAVELING HAND-BOOK
AND
GEOLOGICAL RAILWAY GUIDE

MACFARLANE

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JAMES MACFARLANE.

In the sudden death, at Towanda, Pa., on the 12th inst., of Mr. JAMES MACFARLANE, not only that community, but also a much wider circle, has suffered a serious loss. As the compiler of *The Coal-Fields of America*, and the *Geologist's Traveling Hand-Book*, both of which books evinced intelligence and care in editing, and no inconsiderable ability in authorship, Mr. MACFARLANE conferred a benefit upon many readers and students, and the large sale of these works testified both his correct perception of the need for them, and the skill with which he satisfied it. He contributed valuable articles also to Appleton's Cyclopædia and to various scientific journals, and held at the time of his death, as he had held for years, the position of a Commissioner of the Second Geological Survey of Pennsylvania.

Born at Gettysburg in 1819, Mr. MACFARLANE was graduated at the Pennsylvania College in that town, at the age of eighteen, and began his career as a civil engineer on the North Branch Canal. He subsequently studied law, and was admitted to the bar in 1845. In 1857, after a successful career as a lawyer, he returned to engineering practice, becoming superintendent of the Barclay Coal Company, and remaining in that position until, in 1865, he organized the Towanda Coal Company. When that passed into the control of the Erie Railroad, he became general sales agent of the Associated Blossburg Coal Company, with offices at Rochester, Syracuse, and Elmira. In 1880, he organized the Long Valley Coal Company, and opened its collieries. Still more recently, he was chosen as arbitrator by the "bituminous coal combination"—a conclusive proof of the high esteem in which he was held by his business colleagues. That a man so burdened with labors and responsibilities should find time to devote himself to literary and scientific work is matter for admiration and imitation.

His death (from heart disease) was wholly unexpected, and cut him off in the apparent prime of his strength and usefulness. Not only as one of the most enterprising and effective of those who wrought the industrial development of the region in which his life was mainly spent, but also as a genial companion, a generous friend, a sincere, warm-hearted Christian, he will long be remembered and mourned.

The earlier members of the Institute of Mining Engineers will recall the zeal and cordiality with which Mr. MACFARLANE entered into the operations of that society, at a time when the support of such men was vitally important to its success. After a while, when the vigorous growth of the Institute had placed it beyond the need of any special nursing, he gave up his connection with it, regretting that his engrossing occupations made the surrender necessary. This regret he expressed again to us, the last time we had the pleasure of meeting him. It was shared by the active members from whom he had thus been parted; but his withdrawal could not obliterate their gratitude for his services in the critical period of the Institute's history; and they never ceased to regard him as still, in spirit, a colleague.

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THE GEOLOGIST'S TRAVELING HAND-BOOK.

AN AMERICAN
GEOLOGICAL RAILWAY GUIDE,

GIVING THE

GEOLOGICAL FORMATION AT EVERY RAILWAY STATION,

WITH

NOTES ON INTERESTING PLACES ON THE ROUTES,

AND

A DESCRIPTION OF EACH OF THE FORMATIONS,

BY

JAMES MACFARLANE, PH. D.,

AUTHOR OF "THE COAL-REGIONS OF AMERICA," AND ONE OF THE COMMISSIONERS OF THE SECOND
GEOLOGICAL SURVEY OF PENNSYLVANIA,

WITH THE COÖPERATION OF THE STATE GEOLOGISTS, AND OTHER SCIENTIFIC GENTLEMEN.

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THE OBJECTS AND USES OF THIS WORK.

1. FOR THOSE WHO ARE NOT GEOLOGISTS.

The United States are intersected by numerous railroads leading in all directions, and nearly every one has occasion more or less to travel on them for considerable distances. In these railway journeys no person who has the least power of observation can fail to notice the peculiarities in the scenery and the great variety in the formations of rock to be seen in the railway cuts and cropping out on the hillsides. If we always had a professor of geology for our traveling companion, we would be glad to learn from him what these various formations of rock are, what place they occupy in the series of strata that are visible on the earth's surface, and their mineral and other productions; also at what other localities the same rocks occur, and whether they are entirely new to us or the same we have seen elsewhere. This work is a substitute for the supposed traveling professor of geology, giving in a small space the names of the geological formations which occur along the lines of the railroads, and in another part of the book is to be found a plain but full description of each of them. There are also foot notes directing attention to interesting geological places and objects on the routes of the railroads. One object of the work is to teach persons not versed in geology something of this science during the tedious and unprofitable hours of traveling, without study, not as in a text book, but by pointing to the things themselves as seen at railway stations and through the windows of a railway car.

No person could be so stupid as to travel all over the United States without learning the name of a single state or city through which he passes, yet how few persons know even the names of the geological formations on which they have spent their lifetimes. Every one is taught geography, and there is scarcely a child of sufficient age who cannot tell the name of the town, county and state in which he lives. But geology, which is just as well worth knowing, is neglected, and there is but little opportunity for learning any thing practically in regard to it from those about us. This is not owing to a want of a desire for knowledge, but to a want of instruction in this science, and of the practical application of what is learned by adding local geological information in a handy, cheap and accessible form, and this, which no other work affords, it is the aim of this book to furnish.

There are some kinds of knowledge too that cannot be obtained from books, but must be gathered by actual observation. The inspection of a formation in nature, which is pointed out to you, will teach you more in regard to it in a few minutes than you could learn from lectures or from reading books in as many hours, and the lesson so received will be better remembered. This book is intended as an intelligent guide to such observations. It tells you where the various formations are, and you can then see for yourself in traveling what they are.

How lonely would be a journey on which you would see not a single face that you know, and how different it would be if every one you meet were an old friend. So to the tourist new charms must be given to scenery, however attractive it may already be, if he knows something about its geology. The rocks, mountains, valleys and plains, although he sees them for the first time, are old friends in perhaps new and interesting forms. He meets them with a certain pleasure, for he understands what he sees and he is given the materials for many a happy hour of quiet and profitable reflection at home, on what he has seen on his railway journey.

2. FOR GEOLOGISTS.

But while the book is thus intended primarily as a series of object lessons for those to whom geology is yet a novelty, for the purpose of exciting an interest in, and which may ripen into a love for the science, it is believed that, being in a more convenient form than geological maps, and as no other work has attempted what is here done, all geologists, and especially students, will find it a most useful hand book on their railway journeys as well as for reference at home. It will be useful in laying down the geology in colors on any map which gives the railroads. Accurate geological maps can thus be made without expense, and there is no better exercise for students. It will also be invaluable in selecting a route of travel for geological study or for pleasure, and no geologist should make an excursion over new ground without this guide. It is a scientific catalogue of the great panorama that passes with its ever shifting scenery before the eyes of the American railway traveler, and even an artist finds a catalogue of a picture gallery very necessary. No geologist need be told that it embraces the result of a vast amount of learning, labor and research in a very small compass, and a minuteness of local geology for which he might ransack libraries in vain, and which no one man could possibly furnish. Many men for many years have devoted the finest talents in America to the study of the geology of these states, and all have contributed by their published reports, or by direct original contributions to this work, portions of the knowledge which is here indexed, otherwise it would not be becoming for the author to say so much in its praise. In order that the guide might be as accurate as possible the assistance of the state geologist of each state, or that of some scientific gentleman best acquainted with its local geology, has been invoked to revise and correct the list of formations found along the railroads. Without a single exception, and with characteristic devotion to the cause of science,* this aid has been very cheerfully and promptly rendered, and in not a few instances, where the necessary information was only in the knowledge of these gentlemen, they have filled in the geology from original sources not yet published. Due credit is given to all contributors in the notes of the proper chapter. The general accuracy of the book can be relied upon as to the formations of each locality as they were understood at the time of its publication, and it may be regarded as in harmony with the latest results of geological research. If errors are found, consider the great number of railroad stations and you will wonder there are so few.

*Scientific men freely give the results of their labors to the world, expecting only in return to enjoy the consciousness of having added by their investigations to the sum of human knowledge, and to receive the credit to which they might justly entitle them. PROF. JOSEPH HENRY.

3. FOR USEFUL, PRACTICAL PURPOSES.

To those who take only utilitarian views and care nothing for pure science, and to all those in any way interested in the country, a means is here furnished for ascertaining the natural advantages or disadvantages of any district where there is a railroad, for it is now pretty well known to all intelligent persons that the capabilities or resources of a country, what it is and what it can become, depend chiefly on its geology.

No one in our day can doubt, that there is a definite and orderly arrangement of the rocks, that it is only in certain rocks that certain useful materials and minerals are to be obtained, and that the soil of each formation has a certain fixed value for agriculture. It was long ago shown that a geological map of England, is a map also of the distribution of its manufactures. Even the kind of people inhabiting a district, often depends on its geology. A considerable portion of the work of geologists, is devoted to tracing out the distribution of the various formations as they come out from beneath one another, and spread over the face of the country. This book is made up of a minute tabular statement or division of all places on the American railways, into classes, some of which yield useful materials or productions peculiar to them. It points out the limits to be observed in searching out new locations producing any material. Besides, if accompanied by a correct scientific knowledge of the country, it will make any man's discovery of anything useful available to his neighbors in hundreds of other places, over the whole region covered by the same formation.

The physical structure of a country being then, the means by which we can learn the range and distribution of useful materials, a strict attention to fossils is necessary, to enable us to determine the relative position of rock groups, each group, within certain limits, holding its own peculiar fossil forms, and certain economic products being confined, over wide areas, either wholly or principally to certain rocks. Many persons, ignorantly confounding the means with the end, think geologists are good authorities upon fossils, but not as to the useful properties of the formations. Sir William E. Logan, the great Canadian geologist, in answer to this objection, once said: "I am not a naturalist; I do not describe fossils, but use them. They are the geologist's friends, who direct him in the way to what is valuable. To get the necessary information from them, you must be able to recognize their aspect, and in order to state your authority, you must give their names. Some of them tell of coal—they are cosmopolites; while some give local intelligence of gypsum, or salt, or building stone. One of them helped us last year to trace out, in Canada, upwards of fifty miles of hydraulic limestone."

But it is not practicable for ordinary readers to understand the difficult science of paleontology; all they can expect to know are the results as ascertained by professional geologists, and those results are given in this little book, for every place on every railroad in America. There are many other things that might have been given, especially the structural geology of each State, geological maps, more minute lists of elevations and general physical geography, but the book contains enough for one little volume to be carried about on railway journeys.

TOWANDA, Pa., 1878.

JAMES MACFARLANE.

Business Office, Syracuse, N.Y.

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The numbers and letters of this table are attached to the same formations or their equivalents throughout the book.

DESCRIPTIONS OF THE GEOLOGICAL FORMATIONS.

INTENDED FOR RAILWAY TRAVELERS WHO ARE NOT VERSED IN
GEOLOGY.

All the rock-formations which appear on the surface of the globe, have been scientifically classified by geologists, according to the order in which they are found lying one upon another, and by the fossils they contain, and for our object may be conveniently included in twenty divisions or groups. In this work, the table of the names of the formations, groups and systems, published by Prof. J. D. Dana in his "Manual of Geology" and in his "Text Book of Geology," has been taken as the general basis, by the geologists of many of the states who have assisted in preparing the following guide, but other valuable tables and especially one arranged by Dr. T. Sterry Hunt, preceding the chapter on Canada, and a list for each state at the beginning of the proper chapter, are also given. Numbers are attached to the names of the groups wherever they occur, making 20 in all. The subordinate members of each group, which are called formations, have the same number, but these sub-divisions are distinguished by the addition of small letters, a, b, c, etc., thus making in all 40 sub-divisions. By this means, the reader, although not familiar with geological tables, is at once enabled to see to what part of the general series any formation belongs, number 1 designating the oldest and number 20 the upper and last formed of all. Wherever the formations are found, they occur in the order as they are numbered, but the series in nature is never full, and in almost every locality one or more members of it are wanting.

The true method by which each of the great stratified formations is distinguished is by its own characteristic fossils, but these descriptions, having been prepared for travelers, are confined to the general aspect of the rocks as seen in passing them on the railways. They are intended to be popular rather than scientific, informing the reader what the formations are, what they look like, and their useful and valuable characters, qualities, and productions. It must also be borne in mind that this is a country of vast dimensions, and that the formations undergo important changes in their lithological character from place to place.

Paleontology, and other interesting branches constituting the purely technical portion of the subject, are omitted. That ground has been well covered by all of the excellent illustrated text-books on geology, and one object of this work is to induce persons to take up their study. Results only are here given, not the method, by which they are attained. The thicknesses of the formations are sometimes stated, but as this might mislead the unprofessional reader, it should be observed, that the width of the surface occupied by a formation depends on the amount of dip in the beds. A group less than a hundred feet thick, lying horizontally, may cover several miles, while one of several thousand feet thick, if lying at a high angle, is soon passed over.

I. EOZOIC, (ARCHÆAN, AZOIC.)

I. PRIMARY OR CRYSTALLINE ROCKS.

The late investigations of American geologists have enabled them to establish several divisions in the crystalline stratified rocks, which were originally called Primary or Primitive. The name Azoic, formerly given to the Primary rocks to distinguish them from the Paleozoic formations, has, since the discovery of Eozoön in the former, been exchanged for that of Eozoic. The designation Archæan or ancient rocks, is used by Professor Dana and others, and applies to the Primitive formations without distinction. Among those who have made the Primitive or crystalline rocks a special subject of study for many years, no one is more eminent than Dr. T. Sterry Hunt, and as no proper account of the four groups into which he divides them;—namely, 1 a. Laurentian, 1 b. Norian, 1 c. Huronian, and 1 d. Montalban, has yet appeared, the following descriptions, which he has kindly furnished for this work, are a very valuable contribution to the science of geology.

1 a. Laurentian.—The name of Laurentian was given in 1854, by the geological survey of Canada, to the ancient crystalline terrane which forms the chief portion of the Laurentide hills of Canada, and the Adirondacks of Northern New York.

Throughout these areas the prevailing rock is a strong, massive gneiss, reddish or grayish in color, sparingly micaceous, but very often hornblendic. The predominance of this mineral occasionally gives rise to a nearly pure hornblende-rock, sometimes with a little intermixed feldspar. The gneisses are, for the most part, distinctly stratified, but occasionally the evidences of stratification are not very apparent, so that these rocks have often been designated granites. This series is distinguished by the absence of chloritic, talcose, argillaceous or micaceous schists. It includes, however, crystalline limestones, of which there are supposed to exist, on the Ottawa, three distinct formations in the Laurentian series, each of which is, in parts, according to Logan, more than 1000 feet in thickness. These limestones, which are generally coarsely crystalline, are often magnesian, and abound in foreign minerals, chief among which are serpentine, chondrodite, hornblende, pyroxene, magnesian mica, apatite and graphite. All of these occur both disseminated in the beds, and, aggregated with other minerals, in veins, or endogeneous masses. Associated with these limestones are often considerable beds of quartz-rock, sometimes garnetiferous. Great masses of magnetic oxide of iron are also found interstratified in this series. The measured thickness of the Laurentian gneisses, with their included limestones and other rocks, on the Ottawa, where the strata are nearly vertical in attitude, has been estimated at over 17,000 feet. Beneath these, known as the Grenville series, there is a great mass of granitoid gneiss, without limestones, and of undetermined thickness, called the Ottawa gneiss, which, it is conjectured, may not be conformable with the upper portions, but is, as yet, included in the Laurentian series.

In the Atlantic belt, considerable areas of Laurentian occur in Newfoundland, and probably in several parts of New England. A range of Laurentian rocks from the western part of Connecticut extends southwestward, forming the Highlands of the Hudson, and making the South Mountain as far as the Schuylkill; while a smaller range of the same, to the southeastward, forms the Welsh Mountain, in Pennsylvania. Little is known of the distribution of the Laurentian farther southward along the Atlantic belt, but the gneisses near Richmond in Virginia, and those of Roan Mountain, in North Carolina, are referred to this terrane.

Large areas of Laurentian occur around Lake Superior, and farther west in the Rocky Mountains, where they form the crystalline rocks of the Colorado range in the east, and the Wahsatch in the west, and probably occur in many other parts of the region. To the Laurentian belong the gneisses of the Western Islands of Scotland, those of Scandinavia and Finland, and large portions of those of the Alps. The limestones of the Laurentian contain the remains of a foraminiferal organism known as *Eozoon Canadense*, (Dawson) which has been found in several localities in Canada, and also in Bavaria, and in Finland. Accompanying it are several other small forms, regarded as organic, and referred to the protozoa.

1 b. Norian.—The upper portion of the Laurentian series on the Ottawa river, was originally defined by the geological survey of Canada as consisting of a rock, gneissoid or granitoid in character, made up chiefly of labradorite, or related anorthic feldspars, but including also true gneisses and crystalline limestones, not unlike those already described in the Laurentian. Subsequent studies in Canada led to the conclusion that these rocks constitute a distinct terrane, resting unconformably upon the gneisses and crystalline limestones of the preceding series, and the two were respectively designated as Lower Laurentian, and Upper Laurentian or Labradorian. As the newer is very distinct from the older terrane, it has, however, been thought better to restrict the name of Laurentian to the latter. A series precisely similar to the upper one occurs in Norway, where, as in North America, it rests upon Laurentian gneisses, and where the name of norite has been given to the feldspathic rock which is its chief characteristic. Hence the name of Norian, which has been chosen, in place of Upper Laurentian, as the designation of the terrane. It is conjectured, from the fact that it has yet been found only in contact with the Laurentian, and from its including gneisses and limestones lithologically similar to those of the latter, that it is next in age.

The norites consist, for the greater part, of anorthic feldspar, sometimes almost without admixture, but at other times accompanied by small portions of hornblende, of pyroxene or of hypersthene, constituting what has been called hypersthene or hyperite. Red garnet, green epidote, biotite, and ilmenite are often present, and all of these minerals are generally arranged in such a way as to give a gneissoid structure to the rock. The texture is sometimes fine-grained and compact, and at other times more coarsely granular, and even granitoid, displaying great masses of anorthic feldspar, frequently opalescent, and varying in composition from anorthite to andesine. The colors of the norites vary from white, pale bluish or greenish to dark lavender or smoke-blue, or nearly black. The characters of the associated gneisses and limestones, as already remarked, are similar to those of the Laurentian. Great beds of highly titaniferous iron ore abound in the Norian series.

The principal area of this terrane known in the United States is in Essex County, New York, where it covers several hundred square miles, and, although highly inclined, rests unconformably, according to Professor Hall, upon the Laurentian. It is well displayed upon the shore of Lake Champlain between Port Kent and Westport, and forms some of the the highest hills of the interior. A second large area of Norian occurs north of Montreal, where it is similarly related to the Laurentian, and passes below the Potsdam sandstone. Other localities along the valley of the St. Lawrence are at Château Richer near Quebec, at Bay St. Paul, the Bay of Seven Islands, and on the River Moisie. Extensive areas of it also exist on the coast of Labrador. The same rock has been found on the east shore of Lake Huron, and in Wyoming Territory. Boulders of it are occasionally found along the eastern shores of Maine and Massachusetts, and also in northern New Jersey, whence it is conjectured that the Norian terrane may occur in the South Mountain.

1 c. Huronian.—The name of Huronian was given, in 1855, by the geological survey of Canada, to a great series of more or less schistose crystalline rocks, shown to rest unconformably upon the Laurentian gneisses, on the north shores of the lakes Huron and Superior, and to make up a part of the Huron Mountains, on the south side of the latter. A similar terrane forms a great portion of the Atlantic belt in Newfoundland, in the province of Quebec, and in western New England, where these rocks have been described as the Green-Mountain series, and are traced southwestward along the Blue Ridge. Another range of the same stretches along the northwest side of the Bay of Fundy, and thence is traced, at points, along the coast of Maine, to eastern Massachusetts and Rhode Island. The rocks of this series are everywhere highly disturbed, often vertical, and have a thickness of many thousand feet.

In this series, the gneisses of the Laurentian are represented by rocks consisting essentially of an admixture of orthoclase-feldspar and quartz, which frequently assumes the character of a jaspery petrosilex, becoming porphyritic by the presence of crystals of feldspar, and of quartz, in a compact base. In other cases, it becomes granular, constituting a eurite, and passing into a fine-grained gneissic rock, the colors being generally of some reddish or purplish tint. These petrosilex rocks, which resemble the *hällfinta* of the Swedish geologists, are sometimes schistose, and finely laminated, but at other times are compact, and almost destitute of stratification. The basic portions of this terrane are represented by varieties of greenstone (diorite or diabase) which are often chloritic, and pass by insensible degrees into chloritic schists, frequently with epidote. Steatites and dark colored serpentines also abound in parts of this series, besides what are commonly called talcose or nacreous schists, owing their peculiar characters to a soft hydrous mica, which is not unfrequently disseminated in very quartzose beds, and gives to such a schistose character. The limestones of this series are, for the most part, dolomitic, and often weather to a rusty yellow, from the presence of more or less carbonate of iron. These dolomites are sometimes replaced by crystalline magnesite. Portions of this terrane, including alike chloritic, dioritic and quartzose rocks, are conglomerate in character, frequently containing pebbles derived from the Laurentian, with others from unknown sources. The Huronian series abounds in ores of copper, chrome, nickel and iron. To it belong the specular and magnetic ores of northern Michigan; while the ores of these same species in southeastern Missouri are found in Huronian petrosilex-porphyrries. These last are best seen in

the region just named, in the South Mountain in Pennsylvania, south of the Susquehanna, and along the eastern coasts of Massachusetts and New Brunswick. The Huronian rocks are penetrated in many cases by eruptive rocks, both granites and dolerites. A series of rocks, which the writer has referred to the Huronian, appears in parts of the British Islands, notably in Donegal, Ireland, in Anglesea, and in Caernarvonshire. The crystalline rocks which underlie unconformably the Lower Cambrian strata in South Wales, and to which the name of Dimetian has lately been given, seem, from the descriptions, to belong to the Huronian terrane. The great series in the Alps, called by the Italians the greenstone group, or *pietra verdi*, has both the lithological characters, and the geognostic relations, of the Huronian; and the similar crystalline schists found in California, in the foot-hills of the Sierras, and in the Coast range, are probably to be referred to the same horizon. The gold-bearing veins of California are found both in these crystalline schists and in the eruptive granites.

1 d. Montalban.—This name was given, in 1872, to a great mass of crystalline schists, which are lithologically and geognostically distinguished from the Huronian, and are well displayed in the White Mountains (whence their name). They occupy large areas in New England, and constitute the gneisses and mica-schists of New York Island, of Philadelphia, Baltimore and Washington. A similar group of rocks is found at the summit of the Huronian series, in northern Michigan; and from this, as well as from the facts observed on the Schuylkill, and many other places, they are believed to be younger than the Huronian, although some geologists have supposed them to be older. Similar rocks are traced south-westward from the Potomac, throughout the Blue Ridge, of which they form, in Virginia, North and South Carolina and Georgia, an important part, and are there gold-bearing.

The gneisses of this series are distinguished from those of the Laurentian by being finer grained, and having white feldspar. They are, moreover, less firm, and more tender, often containing silvery mica, and pass by insensible gradations into the coarse mica-schists of the series, which are very unlike in aspect to the soft unctuous mica-schists of the Huronian. Hornblende prevails in many parts of the series, and the gneisses, by its predominance, pass into a bluish-black hornblende-rock, often thin-bedded. Noticeable among the basic members of the terrane, is the granular olivine or chrysolite-rock, which, often accompanied by enstatite, and by serpentine, appears to be interstratified in the micaceous and hornblende schists of the Montalban, in North Carolina, and in Georgia. Crystalline limestones are found in this terrane, often in considerable masses, and resemble somewhat, in the presence of hornblende, apatite and graphite, the limestones of the Laurentian.

The Montalban series exhibits beds and veins of iron-pyrites and copper-pyrites, in many localities, but the oxidized iron-ores which abound in the preceding series, are scarcely known in this. The fine-grained gneisses of the Montalban, are commonly known in New England by the name of granites, but the series is also penetrated by great masses of true eruptive granite. The mica-schists of the series are remarkable for the abundance of crystallized garnet, staurolite, chiastolite and cyanite which they contain; these species, with the exception of the first, not being, so far as known, found in the Laurentian series. The endogenous granitic veins, carrying muscovite, dichroite, spodumene, tourmaline, beryl, columbite, tinestone, and apatite, in the Atlantic belt, are chiefly, if not wholly, found in the Montalban series.

T. STERRY HUNT.

2-15. PALEOZOIC.

2-4. CAMBRIAN (OR LOWER SILURIAN) AGE.

2 a. Acadian.—This series is found at Braintree, in Massachusetts, at St. John, in New Brunswick, and at St. John, in Newfoundland. It includes one thousand feet or more of fossiliferous sandstone and shale, and according to Dr. Hunt, corresponds to the Menevian of Great Britain. It has only been found along the north-eastern border of the Atlantic belt. It is remarkable as a fossiliferous rock below the Potsdam, which had, before its discovery, always been considered as the lowest formation of that description on the continent.

2 b. Potsdam.—The Potsdam sandstone, was for a long time considered as the lowest sedimentary fossiliferous rock. It is usually of a purely quartzose character, generally gray, though often striped, and sometimes partially or entirely red. In places it appears as a conglomerate, but sometimes the enclosed masses are angular, showing them to be near their source.—Hall, N. Y. R., 27. It is a hard silicious sandstone, white, red, gray, yellowish, and frequently striped. Some strata of this rock are covered with the most beautifully characterized ripple-marks as perfect as if just formed on the sand of a sea-beach, while the rock is the most indurated kind of sandstone. Its lower portion is a granitic conglomerate, in which large masses of quartz, the size of a peck measure, are often enveloped; they are rounded and water-worn, and held together by a finer variety of the same material. On the Canada slope, where the mass is 300 feet thick, it is wholly a conglomerate, made up of coarse materials. The part which is properly a sandstone, has two principal varieties, a close grained, sharp edged mass, with natural joints traversing it in two directions, but so closely wedged together that it is quarried with difficulty. This is the Keeseville variety, and that of Pa. and N. J. The other, the typical mass at Potsdam, is an even bedded and somewhat porous rock, at many places a distinct friable sandstone, in others a yellowish-brown sandstone, the particles of which are compacted together, so as to form a firm, even-grained mass, with the planes of deposition perfectly smooth and separable from each other, the layers being from two inches to four feet thick. At Potsdam quarries, a layer of 100 square feet may be raised and split into rails, six inches wide and ten feet long, or it may be broken into pieces the size of a brick, with even edges of fracture, and each layer may be separated into many. The color here is yellowish-brown, and a deep red variety occurs at Chazy, resting immediately upon the primitive rock.—Mather, 102. It is nowhere charged with mineral matter, either disseminated or in veins. The native copper of Lake Superior is in an old trappean formation, and has no relation to the neighboring extensive formation of Potsdam. In an economical point of view, the Potsdam is unimportant as a depository of useful substances.

The general color of the stone at Potsdam is yellowish-brown, but the tint of each layer differs somewhat from those adjacent to it, so that the rock, upon the fractured edges, wears a slightly striped aspect. It is the finest quarry stone in the state, being so perfectly workable and manageable.—360. It is an excellent building material, holding mortar well, and makes a dry house.—29. Under the Potsdam, and upon the primary rock, is the position of the specular and red oxide of iron.—V. 267.

In Minnesota, the lower portion of the formation is 400 feet thick, and is hard and often vitreous, and usually of a brick-red color, with very distinct layers, often separated into slaty layers by partings of red shale, strongly marked with fucoidal impressions, frequently ripple-marked and cracked. The upper part of the formation, there called the St. Croix sandstone, is white or buff in color, often friable, and constitutes a heavy bedded or massive sandstone of rounded quartzose grains.—N. H. Winchell.

In Minnesota and Iowa, the Potsdam proper, omitting the St. Croix sandstone, is a friable, crumbling mass, of no value for building purposes except as sand, consisting of a pure silicious sand in minute grains, with a very slight amount of cementing matter. Unless protected by some more resisting rock above it the Potsdam appears in steep slopes, or low, gently swelling hills and mound-like eminences. Those portions which are hard and enduring are cemented by oxide of iron, and have a brown color.

In Wisconsin, the Potsdam is 800 to 1000 feet thick, and has a much larger surface-development than elsewhere, as will be seen by the great number of railway-stations on it. It extends over 12,000 square miles, and contains many fossils not found in New York. Where the Potsdam in Wisconsin is on the surface, and not covered by drift, there is usually a loose, sandy soil, with a sparse growth of small oak and pine timber. This formation is one that has been very properly allowed to retain its original name almost undisputed all over the United States, except that Professor Owen at first called it the *Lower Sandstone*, in the North West to distinguish it from the 3 c., St. Peters or Upper Sandstone.

In Michigan, the Potsdam is the red sandstone, which is emphatically the chief rock that appears upon the immediate coast of the whole south shore of Lake Superior, and forms the Pictured Rocks and the Falls of St. Marie. Here it is of inconsiderable thickness, but it regularly thickens in going westward.—Houghton, 4th R., 500. Some have referred the Lake Superior sandstone to the age of the Chazy, but the late studies of Rominger show that it is really of Potsdam age. The Chicago Tribune office building is of this Lake Superior sandstone, and the Court House at Milwaukee is another conspicuous specimen.

In Pennsylvania, the Potsdam is a compact, fine-grained, white and yellowish vitreous sandstone, containing specks of Kaolin.

The Potsdam formation is supposed by some to be represented in the Green Pond Mountain of New Jersey by a local deposit of coarse conglomerate, 3000 feet thick, but others deny that this mountain is Potsdam. It is less than 30 feet thick where it is seen rising from beneath the limestones of the Lehigh River, but increases in thickness westward and southward, until it comes to be represented in Tennessee by many thousand feet of alternate coarse and fine deposits. See Safford's Geol. R. of Tenn.

3 a. Calciferous.—This group embraces in New York three distinct masses as to character and position, and these alternate and intermix with each other. The first is silicious, compact, and may probably be the continuation of the Potsdam sandstone. The second is a variable mixture of fine, yellow, silicious sand and dolomite or magnesian carbonate of lime, which, when fractured, presents a fine, sparkling grain. It is in irregular layers, which have a shattered appearance, from numerous cracks, the parts being more or less separated from each other. This is the mass from which the name Calciferous sandrock was derived. The third is a mixture of the dolomitic material, which is usually yellowish, very granular when fresh broken, and of a compact limestone, which resembles the Birdseye. The action of the weather gives these layers the appearance of Gothic fret-work, and the color becomes a dark yellow-brown.—V 21. As its name indicates, it is a sandy magnesian limestone, but it is not destitute of beds of pure limestone. The mixture of a variety of mineral matter causes the rock to weather unequally; hence it is often rough externally, portions of the silicious part standing out in relief. There are two quite uniform characters which distinguish the Calciferous, viz: A fine crystalline structure intermixed with earthy matter, and numerous small masses of calcareous spar.—E. 105. Great numbers of quartz crystals are found in the cavities of this formation, many of them very perfect as to form and transparency.—V. 30.

In the Mississippi basin this formation is called the **LOWER MAGNESIAN LIMESTONE**, to distinguish it from the Upper or Trenton limestone. The eastern name, Calciferous or lime-bearing sandrock, does not apply, as it is almost free from sand. As its western name indicates, it is a dolomite or magnesian limestone, and makes an excellent lime for building-purposes. It usually contains about one equivalent or forty-five per cent. of carbonate of magnesia. This limestone forms the summits of the bluffs of the Mississippi; it supports high table-lands that extend back from the river, and forms prominent angles to the summits of the bluffs on either side of that river. These even and heavy layers are those usually quarried for building-stone. D. D. Owen gives descriptions of the picturesque character of the landscape in the region of the Upper Mississippi, and especially the striking similarity which the rock exposures present to ruined structures, and his report is illustrated by beautiful engravings showing the castellated appearance of the cliffs of the Lower Magnesian limestone on the Iowa River. In Pennsylvania it is a coarse, gray calcareous sandstone, containing cavities enclosing very minute crystals of quartz and calcareous spar.

3 b. Quebec.—This group was divided by Sir W. E. Logan into three parts, consisting, in the ascending order, of 1. Levis, 2. Lauzon, and 3. Sillery. But it afterwards appeared that the section on which this order was based was an inverted one, and that the Sillery was the oldest.

The Quebec group is about 7,000 feet in thickness. The lowest, or 1. **SILLERY** subdivision, is a massive greenish sandstone, fine and coarse grained, frequently a conglomerate of white quartz pebbles, and is 2,000 feet thick. The sandstones are sometimes slightly micaceous, with small scales of green and black shale. They usually present massive beds, and at Sillery some of the layers are quarried and used for building purposes at Quebec. The 2. **LEVIS**, or middle portion of the Quebec, is 1400 feet thick. It is named from Point Levis, opposite Quebec, and consists chiefly of fossiliferous limestone-conglomerates. The 3. **LAUZON** or upper

member, as the order is now understood, is 1,889 feet thick, of black graptolitic slates. The Quebec group, however, presents somewhat different characters in various parts of its distribution. The districts where it is developed are characterized by great faults and inversions of the strata, rendering, as appears above, even their order uncertain.

Dr. Hunt, in his table of formations, places the Sillery below the Potsdam and Calciferous, and the Levis above them, including in the Levis alike the graptolitic slates, the Lauzon, and the fossiliferous limestones of the Levis of Logan. The Quebec group extends along the west side of the Green Mountain range, and covers a considerable part of the State of New York, east of the River Hudson, the rocks being part of the non-fossiliferous clay-slate formerly called the Hudson River slate, which outcrops near Poughkeepsie. The area is divided, on the west, from the true Hudson-River slate formation by the great fault mentioned in note 8 of New York.

3 c. Chazy.—To the Quebec group succeeds the Chazy limestone. As a whole, it is a dark, irregular, thick-bedded limestone. At Chazy, New York, on Lake Champlain, it contains many rough, irregular, flinty or cherty masses. At Essex the beds are more regular, and form, in consequence, a better building stone. As a limestone it is purer than the Calciferous, being non-magnesian; the principal foreign matter is silica in the form of chert. It is free from the brown earthy spots, and the masses of brown calcareous spar so common in the Calciferous sandrock.

This formation is 130 feet thick on Lake Champlain, but it is less constant in the series than the others, and as it is not an important formation on the lines of the railroads, an extended description is not here necessary. It is not found in the valley of the Mohawk. Its fossils are found in Pennsylvania and Virginia, but its limits are not there defined. In the Northwestern States the St. Peter's sandstone occupies the same place in the series as the Chazy in the east.

3 c. St. Peter's Sandstone, (Upper Sandstone of Owen).—This is a western formation and does not occur in the Eastern states, but Prof. Lesley thinks it may have representatives in the massive silicious members of the great limestone-mass of from 5,000 to 6,000 feet thick, as measured along the two branches of the Juniata in Pennsylvania. It is first recognized in going west, to the southwest of Winnebago Lake. It is also seen up the Mississippi, near St. Paul and St. Anthony, and on the streams of northeast Iowa, and at La Salle, Illinois, where it is brought to the surface by an anticlinal axis. It is remarkable for its uniform thickness, which is from 72 to 100 feet over a space of 500 miles in length and 400 miles in width. In Central Wisconsin, however, its thickness is very irregular. It is also of the same character throughout, being composed of wonderfully uniform and exceedingly minute grains of sand, held together by the merest trace of cement, so that the mass may easily be moved with shovel and pick, as is everywhere done for the purpose of obtaining sand for mortar. This sandstone, though usually white, sometimes assumes a buff or brown color from the presence of iron, and in some localities it becomes red or is marked by bands of a bright green color. It appears like a recurrence of the Lower or Potsdam sandstone. Being composed almost entirely of pure silica it is, when not colored by oxide of iron, one of the very best materials yet discovered in the west for the manufacture of glass. It is the same as that known in Missouri as saccharoidal sandstone, which is carried to Pittsburg, Pennsylvania, and used by the glass-makers in manufacturing the best kinds of glass. See Note 2, Missouri.

4 a. Trenton Limestone.—Next in ascending order occurs the 4 a. *Trenton* limestone which, in the Northwestern States, is divided into the Buff limestone and the Blue limestone. In Wisconsin there are two buff and two blue beds alternating. They are undoubtedly the same as the well known Chazy, Birdseye, Black River and Trenton limestones of New York and other Eastern States. They are known in the West wherever the exposures reach to the upper sandstone.

The upper member of the 4 a. Trenton limestone, in South Western Wisconsin and the adjoining parts of Illinois and Iowa, is the very important **GALENA** or lead-producing limestone, which has no exact representation in the Eastern States. It is a light gray or yellowish-gray, heavy-bedded rock. It is compact, minutely crystalline throughout, often with small cavities lined with crystals of brown spar, and the whole thickness of the formation is 250 feet. The Galena or lead ore contains 13.4 per cent. of sulphur and 86.6 per cent. of lead, and is found in heavy bodies in crevices in this Galena dolomite or magnesian limestone. Prof. J. D. Whitney, in his admirable report on the geology of the lead region of Southwestern Wisconsin, has proved that these lead deposits must have been introduced into the fissures by precipitation from above. The lead mines of Missouri are chiefly in the Lower Magnesian limestone.

In Wisconsin, a very noticeable feature of the Trenton limestone is its marked division into the two parts before mentioned. One, which is the lower half, is very heavy bedded, in layers of two or three feet thick, known as the glass-rock, and the other thin bedded, in layers of two or three inches. There is always a stratum of carbonaceous shale from a quarter of an inch to a foot or more in thickness, which separates the blue or Trenton from the thin bedded Galena limestone above it.

Professor R. D. Irving describes the Galena limestone as almost invariably a very compact, hard, crystalline rock, of a yellowish-gray color, with numerous small cavities filled with a softer material, or lined with crystals of calcite. The upper portion is thick-bedded and free from flints, the layers being from one to four feet thick, while the lower portion almost invariably consists of several feet of layers from one to two inches thick. Good exposures of parts of the Galena limestone are frequently to be met with. It may be seen in cliffs and ledges, on nearly all the streams in the lead-region, where it weathers irregularly, leaving the surface full of small cavities, due to the removal of its softer parts. The formation contains masses of flint in layers, or in irregular pieces, which are principally confined to the middle and lower parts of the formation, although not entirely absent from any part.

In the interior valleys of Pennsylvania, as for example, in Sinking Valley, Blair Co., considerable quantities of zinc-ore, and some galena, have been found in the Trenton limestone group, which is there at least 1,000 feet thick. The lead-mines of Wythe Co., Virginia, are at the same, or at a somewhat lower horizon. The zinc mines near Bethlehem, Pennsylvania, and near Landisville, Lancaster Co., are nearly of the same geological age. Isolated crystals or small masses of galena occur in crevices in the limestone beds of this age throughout the entire range of the great valley from Newburgh, on the Hudson, to Chatanooga, in Tennessee. The limestones in this valley, which are the Auroral limestones of Rogers', are, by some geologists, referred to an older series. See, in this connection, the foot note on page 21.

In the State of New York the lower part of the Trenton is called the Birdseye. It is a perfectly pure limestone, and the next layer, which is the middle or Black River sub-division, is sometimes used as a marble. It is solid, hard and easily worked, by reason of its conchoidal fracture, and is valuable for lime and for building.

The upper part of the formation, or Trenton limestone proper in New York, consists of two distinct varieties, at Trenton Falls. The first or upper part, is a dark or black colored, fine grained limestone, in thin layers, separated regularly by black shale or slate, forming the great mass in which the creek has worn its channel, and in which are all the falls. See Note 62, New York.

The second, or lower part of the Trenton proper, is a gray, coarse grained limestone, in thick layers, and it is quite crystalline. This is the quarry-stone at Prospect, above Trenton Falls. At Montreal, the church of Notre Dame and many other structures, are constructed of the gray variety of the Trenton limestone, quarried behind the city, but the thinner layers, when not dressed, are of a more pleasing color, and make a handsomer building-stone.

The Trenton formation in all parts of the United States, is almost always a limestone. A conspicuous example of the Trenton, Utica and Hudson River formations, is seen in the long continuous and beautiful valley of the Hudson and Lake Champlain, the Kittatinny valley of New Jersey, the Cumberland valley of Pennsylvania, the Shenandoah valley of Virginia, and the valley of East Tennessee. The fertility of its limestone land is almost inexhaustible. The deposits of brown hematite iron-ore, found in the soil, and occupying hollows or basins in the softer limestones below the Trenton in so many places, and in such large quantities, are supposed by some to be of aqueous origin, and not strictly a product of this formation, which is only its receptacle. But many other geologists,—R. M. S. Jackson, A. A. Henderson, Lesley, Platt, Prime and Frazer, have all agreed in advocating the opposite view, each from his own independent studies. They derive the limonite beds either from the solution of the ferriferous limestone layers, or from the intercalated micaceous slates, or from the pyrites-bearing slates of the neighborhood. According to Dr. Hunt, it comes from the change of masses of iron-pyrites and of carbonate of iron, originally imbedded in the limestones and slates. See the foot note on page 21.

4 b. Utica Slate.—The Trenton limestone is succeeded by a dark or black carbonaceous slate, called the Utica slate. In Pennsylvania this formation is everywhere darkly colored, and the coloring matter is probably derived from abundant remains of marine plants or animals. While the black color of some of the clays in the brown hematite ore banks of the upper range (immediately beneath the Utica slate) as at the mines in Lehigh Co., Pa., and the Brandon ore mine in Vermont, seems to be derived from the black slates of the Utica, the gray color of some of the limestones, and of the carbonate ores, (as at the Saucon zinc mines) is known to be due to disseminated graphite.

Within the State of New York, it is everywhere black, and usually soft and fissile. Thin beds of impure limestone are associated with it in many places, and sometimes thin layers of carbonate of iron, and it passes into the Trenton limestone by gradual interstratification. Thus bands of slate are interstratified in the limestone, and thin strata of limestone containing fossil remains in the lower part of the slate. These crumbling shales may generally be distinguished by their dark blue-black and brownish-black color, but there are some strata among the

grits of the Hudson River that can scarcely be distinguished from these. The Utica slate weathers ash-gray, rapidly disintegrates, and, where it is exposed in cliffs, frost and other agents constantly break it into small fragments, which collect at the base in the form of a talus. In Pennsylvania, it outcrops, with little or no variation, as a dark blue carbonaceous slate and shale, extremely fissile in its lower beds. It forms the surface-rock along a narrow region in the Mohawk Valley. In East Tennessee, the beds both of Utica and Hudson River, or Cincinnati, are of great extent, and consist of blue calcareous and sandy shales, with some layers of calcareous sandstone. Professor Hall considers the Utica slate as properly the lower member of the Hudson River group.

4 c. **Hudson River, (Cincinnati, Nashville, Loraine and Frankfort sandstone and shale.)**—The rocks of this group in New York are mostly slates, shales and gray, slaty and thick-bedded grits. The slates and shales are generally dark brown, blue and black, and the grits are gray, greenish and bluish-gray. They are stratified and conformable, alternating a great number of times, without any regular order of alternation, and in Eastern New York are from 500 to 800 feet thick. The first New York geologists called this formation the Greywacke, and it is still so called by the stone-cutters on the River Hudson. Its lower portion was called the *Frankfort* slate and sandstone, and the upper part the *Pulaski* shale and sandstone, which latter were afterwards called the *Loraine* shale. Wherever streams have passed over it they have, in process of time, worn in the rocks a deep channel or gorge, sometimes preventing a free communication across them, as at Loraine, (See note No 69, New York.) By decomposition, it produces a tenacious, clayey soil, favorable for grass, forming the best dairy-land, as in Orange Co., New York, about Goshen and Middletown. It increases in thickness southward so rapidly that at the Delaware and Lehigh water-gaps, measurements of 5,000 feet have been made through it, from its top downwards, without reaching its lower limit.

In many places along its last outcrop towards the Atlantic, it has furnished many masses of a substance resembling anthracite, also beds of impure limestone, and beds of red shale, which increase very much going south into Virginia.

In Pennsylvania, the Hudson River slate consists of blue and greenish-gray shale, alternating with gray calcareous and argillaceous sandstone in thin beds. The sandstones grow more abundant as we ascend in the formation. The middle portion, where much metamorphosed and intersected by cleavage-planes, in certain localities, produces a good roofing-slate, as at Slatington and Delaware Water Gap, Pa.

The geologists of the western states generally, have dropped the designation of Hudson-River, at least in regard to strata west of the Alleghanies, and have substituted for it the name, CINCINNATI, proposed by Worthen and Meek; making this term co-extensive with the former. In this guide, Hudson-River is used in the Eastern and Cincinnati in the Western States. At Cincinnati the whole series is about 800 feet thick, and, according to Dr. Newberry, by its fossils, is the equivalent of the Chazy, Trenton, Utica and Hudson-River, all blended together. In Ohio it is composed of alternating beds of limestone and shale, the latter sometimes called blue clay. The limestone is an even-bedded, firm, durable, semi-crystalline limestone, crowded with fossils. It is commonly called the blue limestone, but the prevailing color is grayish-blue, and the weathered surfaces show yellowish or light gray shades. In Southern Illinois the lower part of the Cincinnati is composed of brown sandy shales and sandstone, and the upper portion is a thin-

bedded, dark bluish-gray, fine grained limestone, two to six inches thick, with shaly partings between the layers. In Northern Illinois it is bituminous, and consists of sandy shales with thin bands of limestone. In Iowa it is the Maquoketa shales, which are bluish and brownish shales forming a stiff clay soil. In Missouri the upper shale bed only is found, with an occasional flag-like limestone layer.

On the west bank of the River Hudson this formation continues uninterruptedly from Kingston to Saratoga Lake, and on the east side of the river also, it is clearly defined along the valley, with a width of from one to several miles, varying and irregular in outline from Rhinebeck to Lake Champlain, its eastern limit approaching the river at the former place.—J. Hall, A. A. A. Sci. 1877.

The N. Y. C. & H. R. R. R. runs on it for 65 miles, from below Rhinebeck to Troy, and the formation continues along the river many miles further northward. The name Hudson River is, therefore, highly appropriate for the formation. The shales and impure sandstones are upturned, and thereby modified in character along the river, but they are no older than the horizontal rocks in the Mohawk valley, a few miles west of the River Hudson, and at Frankfort, Lorraine and Pulaski. They have the same fossil contents, and their direct continuity can be traced. There is, it is true, a great mass of metamorphic shale and sandstones to the eastward of those on the river above described, and between them and the state-line, which contains different fossils, and belongs to an older formation, called the Quebec group. But the Hudson River formation is the same which extends through Canada and the Northwestern States, and southward through Ohio, Kentucky and Tennessee, where it is called the Cincinnati and Nashville formation. It is very much to be regretted that the original name of Hudson River has not been everywhere retained.

There is more confusion and uncertainty about the Cambrian or Lower Silurian formations in many localities than about any other portion of the whole series. The difficulties arise from the scarcity of fossils, the disturbed and altered state of the greater part of its rocks, from the absence of those which should immediately precede and follow them, and which if present would show their position in the series, and also from the difficulty of distinguishing them from those of greater age adjoining them, and with which they are really or apparently blended.*

*Overlying the various crystalline terranes described on pages 10-13, along the western border of the Appalachian mountain belt from the Gulf of St. Lawrence to Alabama, are found extensive formations, differing, it is said, from those, and from the fossiliferous rocks above them, which have been the subject of much discussion. To these rocks, as displayed in the Taconic hills of New England, Prof. Emmons gave the name of the *Taconic system*, which he divided into a lower and an upper series. The views of Emmons are still held by Dr. T. Sterry Hunt, and others, and there is a growing belief in favor of the existence of such a series of rocks; but they are opposed by Mather, Hall, Logan, Rogers, Dana, and the great majority of American geologists, who hold that Emmons's Lower Taconic series is the stratigraphical equivalent of the Potsdam, Calcareous, Quebec, Chazy, Trenton, Utica and Hudson River, and his Upper Taconic, of the succeeding Oneida and Medina formations; their lithological differences from the same formations further west, being due to some agency which has changed them, inducing crystallization, and obliterating their organic remains. The purposes of this work will be best subserved by describing the formations in accordance with the received opinions of geologists, generally, without entering on controverted ground, and merely stating briefly, that what is designated as the Upper Taconic, extends from Orange County, New York, above Newburg, across the River Hudson, and through Dutchess and other counties of Eastern New York; thence through Western Vermont and Canada, as far as the city of Quebec and beyond. The Lower Taconic, including a granular quartz-rock, and the Stockbridge limestone, with roofing-slates, and soft, so-called talcose slates, extends from Vermont along the western base of the South Mountain and the Blue Ridge, underlying the great Appalachian valley, as far as Alabama, and having a thickness of 5000 feet. There is also a range, more or less continuous, of this formation, from Delaware into North Carolina, where it is found at the eastern base of the Blue Ridge, resting on the Montalban.

According to Dr. Hunt, the Lower Taconic constitutes a fifth crystalline series, younger than the Montalban, and by him distinguished by the name of *TACONIAN*, which includes the Auroral limestones and the Primal slates of the Appalachian valley, with their limonites and crystalline iron-ores, and also the Itacolumites and the pyrophyllite slates of North Carolina. The Upper Taconic, which comprehends the Quebec group of Logan, consists, in his view, of uncrystalline ~~rocks~~ Cambrian age, below the horizon of the Trenton limestone.

5-8. SILURIAN (OR UPPER SILURIAN) AGE.

5 a. Medina.—The lower member of this formation is a pebbly sandstone or grit called the Oneida conglomerate, being the same as the Shawangunk conglomerate. The upper member is called distinctively the Medina sandstone, and is usually a red or mottled argillaceous sandstone.

1. The Oneida conglomerate in New York is composed of quartz pebbles rarely exceeding three-fourths of an inch in diameter, and of white or yellowish quartz-sand. In some localities there is some interposed greenish shale. The source of its materials was to the south, the rock being 500 feet thick in the Shawangunk Mountain at Wurtsburg, on the N.Y. & Os. Mid. R. R., and 1000 feet thick in some parts of Pennsylvania and Tennessee. The greatest thickness of the Oneida in the eastern part of New York is 80 to 40 feet, but in the western part the same place is occupied by a gray quartzose sandstone, fine grained and compact. Passing upwards, the gray sandstone intermingles with the Medina sandstone, which, in its lower parts, differs chiefly in color. The red color of the Medina sandstone seems to be partially communicated to the gray below, which is often striped and spotted with red. There is, lithologically, no very strong line of demarcation between the two rocks. The oxide of iron, the red coloring matter of the upper member, has been transfused through the material of the lower as far as its particles could find admittance. The flagstones in the side-walks of Buffalo and Rochester, of a white color clouded with red, are of this formation.

In New Jersey the gray sandstone formation consists of a thick series of hard, white and whitish gray siliceous rocks, of various degrees of coarseness, from that of a fine grained, pure sandstone to that of a quartzose conglomerate with thickly-set pebbles averaging half an inch in diameter. This is the summit of the long, straight mountain ridge called the Kittatinny or North Mountain, extending from near the Hudson River into Virginia.

In Pennsylvania the Oneida conglomerate is a compact, greenish-gray, massive sandstone, containing in many places thick beds of siliceous conglomerate, and the Medina sandstone proper is a thick mass of alternating red shales and red and gray earthy sandstones. It is the North Mountain of the great Cumberland valley.

At the Delaware Water-Gap the whole mass of Oneida and Medina consists of seven massive plates of coarse sand and conglomerate, separated by more argillaceous layers from each other. Going west, the number, according to Prof. Lesley, is reduced to five, and finally in Middle Pennsylvania to two, each of them very thick, and making its own mountain-crest when the dip is vertical, while the intermediate softer red mass forms a little valley between the crests. The whole formation is about 1,900 feet thick. When the dip is gentle, the Oneida makes a beautiful lofty terrace upon the flank of the mountain, the crest of which is always made by the Upper Medina. Traced southward through Virginia into Tennessee, this formation gradually thins away to 50 feet, as seen west of Knoxville.

2. The Medina sandstone proper succeeds the gray sandstone, there being no definite line of division between them. In this rock is found the *Fucoides Harlani* affording a positive character whereby to recognize it in the series. This sandstone is almost invariably of a red color, generally a brown-red, more rarely variegated light red and yellowish, and in a few rare instances of a light or whitish color,

partially greenish. It is both fine grained and coarse grained, the latter usually of the deepest color, the former more variegated. The lower falls of the Genesee, below Rochester, 110 feet in height, are formed by this rock. The deep gorge and high cliffs on both sides of the Niagara River, at Lewiston, New York, are more than one-half excavated in the Medina.

In New Jersey it is a thick formation of red and variegated sandstones and shales. Its lower beds are a dark red sandstone of a very ferruginous composition, and extreme hardness, and in the middle and upper divisions of a brownish red shale and a very argillaceous sandstone, partly calcareous.

Neither the Oneida nor Medina are found west of Ohio. Some large masses of galena and copper-pyrites with blende, have been found in the Oneida or Shawangunk grit, on the Erie R. R. east of Port Jervis and at Ellenville, but they were soon exhausted. When the Medina is a heavy coarse rock it produces a poor, barren country, but in Western New York it is more calcareous, and the soil is much better.

5 b. Clinton.—This group consists of many different kinds of rocks or masses, from which circumstance it was first called the Protean group. The name of Clinton was given to it on account of the characteristic masses being found around the village of Clinton, in Oneida County, New York. It consists of green and black-blue shale, greenish, gray and red, soft marly layers; often laminated calcareous sandstone, encrinal sandstone, and red fossiliferous iron-ore beds. The most persistent member of the group is the shale. It is bluish when fresh quarried, but when long exposed it is always of a greenish hue. The next member is the greenish sandstone, which is in thin layers, having its surface generally covered with *fucoides*. This also has a bluish tint when fresh quarried. The third persistent member consists of two iron-ore beds in New York and several in Pennsylvania.

The term Protean is still applicable to the Clinton group, which, in some places, consists of thin shaly sandstones, shales, and even conglomerates; in others, of thin bedded, impure limestones, shaly sandstones, iron-ores, etc: still again it appears as a duplicate series of shales, limestones and iron-ores, with some intermixture of sandy matter, all containing an abundance of marine shells. In the west the formation is limestone, and is of a more uniform character.

The Clinton formation produces the celebrated fossiliferous iron-ore, generally known as the Fossil ore, which occurs in it in every state from New York to Alabama. In all its localities this ore is red or brownish-red, very hard, and where unaltered, invariably oolitic or in larger sized concretions. In New York, where it is extensively mined, there are two beds of it, generally about 20 feet apart, and upon an average about a foot and more in thickness. The oolitic particles are usually more abundant in the lower, the larger sized concretions in the upper bed. The two beds never appear at the same locality, or in the same line of section, but where the lower one occurs the upper one is wanting, and where the upper one occurs the lower one is not found.

In Pennsylvania the Clinton is a very extensive formation, nearly 2,000 feet thick, of slate, shales, sandstones and iron-ore, with the same variety as elsewhere, and its iron ore is very rich, productive and valuable. The outcrop of the ore-beds have been traced for hundreds of miles. In Dodge County, Wisconsin, near Milwaukee, the Clinton iron-ore, at Iron Ridge, is from 15 to 18 feet thick, but this is very unusual, and it is not in the same part of the formation as the fossil ore in the east. The deposits of this ore in East Tennessee and in Alabama, called the Dye-stone ore, are still more extensive.

5 c. Niagara.—This group consists of two distinct members, a shale below and a limestone above.

The shale in New York constitutes a very uniform deposit, while the limestone, from a thin concretionary mass in the east, becomes an extensive and conspicuous rock, constantly increasing in thickness, in a western direction, even far beyond the limits of that state. The cataract of Niagara is produced by the passage of the river over this limestone and shale, and, from being a well known and extremely interesting point, as well as exhibiting the greatest natural development of these rocks in New York, this name was adopted for its designation. In this vicinity, the limestone is 164 feet thick, with the shale beneath 80 feet thick. The lower part of the Niagara group exhibits a great development of dark bluish shale, which, on exposure, gradually changes to gray or ashen color, and forms a bluish or grayish marly clay. In this state it is undistinguishable from the ordinary clays, and its outcropping edges, when long weathered, are often considered as clay beds. The Niagara is a very extensive formation, but its shales are much more persistent and wide spread than its limestone member in the east, but the limestone is more widely spread in the west. The gorge below the upper falls at Rochester is the best place to study these shales. In an agricultural point of view, this formation, like all limestones, is an admirable one. There is no better soil than that of the Niagara about Rochester, New York.

A silico-argillaceous limestone, in New York, forms the beds of passage from the soft shale below to the purer limestone above. It is of a dark or bluish color when freshly exposed, but soon changes to light gray or ashen. These beds of passage are succeeded by a dark bluish gray sub-crystalline limestone, of a rough fracture, and separated into thin courses by dark shaly matter. The third member is a coarse grained concretionary mass, in irregular layers, exhibiting a very peculiar contorted appearance, as if much disturbed while in a semi-fluid or yielding condition. The concretions often present cavities lined with crystals, or contain the remains of some organic body. This is the surface-rock in West Avenue in Rochester.

The Niagara limestone is the great limestone which, in Wisconsin, occupies the peninsula between Green Bay and Lake Michigan, and then stretches southward to the south limits of the state, and far into Illinois and Indiana. It will be noticed in looking over the Guide, how many railroad-stations in the western states, just mentioned are on the 5 c. Niagara, and how very extensive the formation must be. Its general appearance is that of a regularly bedded brown or buff dolomite, with occasional intercalations of beds of massive gray limestone. The quarries of beautiful buff limestone at Athens and Joliet, Illinois, so much used in Chicago for building-purposes, are in this formation. At Joliet there is 40 feet in thickness of this buff and gray limestone. West and northwest of Chicago the Niagara limestone is highly charged with petroleum, which oozes from the stone, blackening the face of walls built of it. On Goat Island, at Niagara Falls, the petroleum is also seen on the limestone in small quantities. In Michigan it is a grey crystalline, rather fine grained, moderately fossiliferous, dolomitic mass, 218 feet thick on Green Bay.

In Western Canada the upper part of the Niagara limestone contains peculiar fossils, and is called the Guelph, and in Wisconsin it is subdivided into the 4. Guelph, 3. Racine, 2. Waukesha and 1. Mayville beds.

This formation establishes the topographical distinction between the lower plain of Canada, in which lie Lake Ontario and Georgian Bay, and the upper plain of the United States, on which lie Lakes Erie, Huron and Michigan. Its terrace crosses Ontario, growing loftier as the thickness of the formation increases northwestward, until it becomes a range of limestone mountain-land, forming the peninsula between Lake Huron and Georgian Bay. It is there broken down in a range of islands, and reappears as a peninsula, just mentioned, cutting off Green Bay from the western shore of Lake Michigan.

The Niagara and other limestones above it, seem not to have been deposited in Pennsylvania between the Delaware and Susquehanna rivers, and in Middle Pennsylvania. While the limestones below it are well represented, the Niagara is wanting as a separate formation, and its characteristic fossils are scattered through the Clinton rocks.

6. *Salina*, (Onondaga Salt Group).—This is an important group in the State of New York, containing all the gypsum and water-lime, and furnishing all the salt water of the salines of the city of Syracuse, which produce more salt in a small territory than any other in the world. Its soil is excellent for agricultural purposes, forming, with those south of it, including the Hamilton, the garden-region of the State of New York. The whole group is about 700 feet in thickness, and is divided into five deposits, but there are no well defined lines of division between them, except the last two.

1. The first or lowest is a red shale, showing green spots at the upper part of the mass. The great mass is of a blood red color, fine grained, earthy in fracture, with no regular lines of division, but breaking or crumbling into irregular fragments, and shows but little variation. In several localities the red shale shows numerous green spots, varying from an inch or less to several inches in diameter, which strongly contrast with the red ground on which they are placed. The green color is the result of a chemical change, the peroxide of iron being reduced to protoxide. This red shale is of great extent along the railroad, and presents a thickness of from one to five hundred feet, yet nowhere has a fossil been found in it, or a pebble, or anything extraneous, excepting a few thin layers of sandstone. The main line of the N. Y. C. & H. R. R. R. runs on the Salina formation 107 miles, from Canastota to Brighton, and nearly all of this distance on this lower or red shale portion.

2. The second deposit is the lower gypseous shales, the lower part of it alternating with the red shale, which ceases with this mass. This second deposit consists of shales and calcareous slates of a light green and drab color, with alternations of different colored masses, red, green, bluish and yellow, with a little whitish and greenish sandstone, different colors predominating in different places. In this deposit gypsum occurs in fibrous masses, either reddish or of a salmon color, which colors are peculiar to this deposit. The quantity of gypsum in this second deposit is comparatively small, and it is unimportant in an economical point of view.

Both the second and third deposits are permeable to water, which cannot be obtained in any of the hills composed of them unless the wells are sunk to the level of the water-courses, a fact which explains the absence of all brine-springs above the level of the country.

3. The third member of the Salina formation is the gypseous deposit, which embraces the great masses quarried for plaster or gypsum, consisting of two ranges, between which are the hopper-shaped cavities, the vermicular lime-rock, and other porous rocks. This is the most important deposit, not only on account of its plaster-beds, but because it is only in this deposit that we have positive evidence that salt has existed in a solid state, and, therefore, the only source whence the saline springs of Syracuse could have been derived. The great mass of the deposit consists of rather soft yellowish or drab and brownish colored shale and slate, and of more compact masses which are hard, a brownish color predominating. It is usually denominated a gypseous marl, being earthy and indurated, slaty and compact. Some of it when weathered, presents a peculiar appearance, as of having been hacked by a cutting-instrument, with some regularity. The gypsum does not appear in layers or beds, but it occurs in insulated masses, and it assumes irregular not globular forms. The dark color of the gypsum is owing to carbonaceous matter. In many localities there are two ranges of these masses or plaster-beds, generally separated by the vermicular rock and the hopper-shaped cavities. There are two masses of the vermicular rock, the upper one four feet thick, with large porous cavities, the lower one twenty feet thick, with small pores. This vermicular limestone is a porous or cellular rock, resembling lava. It is dark gray or blue in color, and perforated everywhere with curvilinear holes, but otherwise very compact. The holes or cells vary from microscopic size to half an inch in diameter, the cells being very irregular, and communicating with each other, some being spherical, and the resemblance in structure to a porous lava is complete. Forms which are due to common salt have been discovered in this rock, showing the presence of crystals of this substance, which were removed by solution.

The most interesting products of the group are the hopper-shaped cavities, which must have been produced by common salt, as no other soluble mineral presents similar ones. They show conclusively that salt existed in this third deposit. When salt crystallizes, a cube first makes its appearance upon the surface of the brine, then similar cubes form around its border, being attached to its upper surface, near the edges, while it gradually sinks, and additional particles are added, forming another row of cubes upon the first range. This is many times repeated, until the density of the mass formed becomes greater than the liquid, when it falls to the bottom. When examined, being turned upside down, it shows a pyramid of regular steps, terminated by a cube, and when its position is reversed it presents a form like the hopper of a mill. Where two ranges of plaster beds are seen the hoppers occur between them, and between the two masses of vermicular rocks, and are from one inch to three inches and more in diameter. These hopper cavities are formed in the gypseous marl, or in the more solid parts of the vermicular rock. Testaceous animals cannot live in water saturated with gypsum, hence no fossils are found in the deposit. No trace of rock-salt in New York has met the eye of any one, but the existence of it is a matter of no doubt.* The fact of the difficulty of obtaining water in the gypseous hills, in either the second or third deposit, show there is little probability of finding salt above the level of the waters on account of its having long since been dissolved. See Note 27, New York, as to the salt-wells at Syracuse.

*After the above was written, rock-salt was first found, in June 1878, in a boring south of Rochester.

The "Old Road," or the division of the N. Y. C. & H. R. R. R., from Syracuse to Rochester, via Auburn, runs on the gypseous portion of the formation, and the plaster-beds can be inspected at Marcellus station, close to the railroad, but the best gypsum quarries are on Cayuga Lake, just north of Union Springs, the masses being from fifteen to twenty-five feet thick. Sulphuric acid springs, and numerous sulphur springs occur in the State of New York, in the Salina formation, often rising through the crevices of the overlying Water-lime group.

4. The fourth or succeeding portion of the Salina formation, consists of those rocks which show groups of needle-form cavities, placed side by side, caused by the crystallization of sulphate of magnesia, and presenting a finely striated columnar appearance. The rock is a dark gray or drab colored, impure limestone, with cavities containing crystals and often embracing shaly beds. It appears to be a magnesian limestone, its usual color is a brownish drab, also dove color, and it breaks with an earthy fracture.

The Salina formation extends westward across Canada, and the salt-deposits of Goderich in Ontario are in it. Six large beds of rock salt have been found there in boring, measuring in all 126 feet in thickness, at from 1,027 to 1,385 feet in depth from the surface, the beds measuring from 6 feet to 35 feet each in thickness.

The salt-deposits and brine-springs of the world are by no means confined to the Salina formation; on the contrary, they are found in almost all the formations from the oldest to the youngest, and always accompanied by gypsum and red and variegated marls.

5. The fifth division of the Salina or Onondaga Salt group is the Water-lime, which has generally been considered as belonging to the Lower Helderberg, but which properly is part of the Salina. All the hydraulic cement of the State of New York, known as Rosendale Cement, and Syracuse or Manlius Water-lime, is manufactured from a portion of the stone of this Water-lime formation. It is an earthy, drab-colored limestone and usually consists of two layers of drab limestone, always separated by an intervening mass of blue; it is easily recognized by its gray or ash color when weathered. It has a thickness of not less than 30 feet, and often attains a thickness of 100 feet or more in New York. When the Water-lime is burnt the stone does not slake, if of a good quality. It is ground in a mill, and then it hardens or sets when mixed with water, and remains so under water, its goodness depending on the hardness or cohesion when set. Its peculiar quality is owing to the proportion of silica and alumina it contains. The Water-lime continues across the State of New York, the drab layers which constitute it being always found. The courses into which the layers of Water-lime are sometimes divided show a crenulated or notched surface, like the sutures of a skull, the two surfaces interlocking each other. Professor Hall says the Water-lime is a distinct member, which does not belong to the 7. Lower Helderberg group of strata, but to that below it, the 6. Salina, of which it is the upper member. It is not closely related to either, but more nearly to the Salina, and is much more widely spread than the other members of the Salina. The cement quarries of the Delaware River, between Pennsylvania and New Jersey are in this formation, but cease after passing the Lehigh River westward. The beds near Copley are Trenton or older. In Middle Pennsylvania, where the Salina group, destitute of gypsum and salt, measures 440 feet, the cement beds above measure 580 feet, and the Lewistown limestone (Lower Helderberg) 163 feet, as measured by Ashburner and Billin, in 1876.

7. Lower Helderberg.—In consequence of these rocks being so well developed on the Helderberg Mountains, near Albany, New York, they have received that name. The Lower Helderberg series consists of five limestone sub-divisions, and the Upper Helderberg of four members. They are separated by an important sandstone formation—the Oriskany. The Lower Helderberg, which is well developed in the eastern part of New York, thins out in going west, and at Syracuse disappears entirely. The sandstones also thin out and disappear, so that at Syracuse the Upper Helderberg rests on the Water-lime, the upper member of the Onondaga Salt group. The Lower Helderberg consists, in ascending order, of the 1. Tentaculite limestone, the 2. Pentamerus limestone, the 3. Delthyris shaly limestone, the 4. Encrinal limestone, and 5. Upper Pentamerus limestone.

1. The Tentaculite limestone is the lowest member of the series. Portions of it afford fine building stone, which can be procured in blocks of large size, perfectly solid, and free from cracks or flaws. They vary from ash-gray to black, and present almost every shade between these colors. The strata are intersected by two main systems of joints nearly perpendicular to each other, hence the rock can easily be quarried in large blocks. But much of it is thin-bedded, often thinly laminated, dark blue; its color, texture and composition contrasting strongly with the Water-lime below.—H. The 2. Pentamerus limestone is rarely pure, being more or less mixed with black shale, which gives a dark color to the rock, it being usually a dark gray. It is crystalline in grain, and is in layers, but the lines of division are not straight, and the surface is not even. The whole mass has a rough appearance, and it does not make a good building stone.—V. The 3. Delthyris shaly limestone, as its name implies, is a shaly mass, and consists of alternate beds of shaly and compact limestone. It is an exceedingly interesting rock from the great number of species, the abundance and perfection of its fossils.—Hall, 144. The 4. Encrinal is a compact crinoidal limestone, and the 5. Upper Pentamerus is a bluish gray limestone. In Pennsylvania, according to Rogers, the Lower Helderberg is 50 to 100 feet thick, a diversified calcareous formation, of some shade of blue, argillaceous and flaggy in its lower beds, and shaly towards the middle, with layers and nodules of chert.

8. Oriskany Sandstone.—In New York the greatest thickness of this rock is not more than thirty feet, and usually much less, but in Pennsylvania, Maryland and Virginia it is, in places, as much as 700 feet; even in New York it covers an extensive surface, and is strongly marked in its fossils, which are generally of a large size, and attract the attention of travelers. At the typical locality, Oriskany Falls, the sandstone is twenty feet thick, and is of a light yellow color, friable, and readily crumbling into pure sand; no part of it being sufficiently solid for durable work. One characteristic of this rock is the abundance of small cavities, which have been formed by the destruction of fossils. These present themselves in all cases where the rock is well developed. The porous nature of the mass has admitted the percolation of water, which has dissolved the calcareous matter of the shells, usually leaving casts of their internal structure. As a mass the Oriskany sandstone is a coarse, rather loosely cemented, purely silicious sandstone, of a yellowish white color. Sometimes it is shaded brown or some other dark color. In Pennsylvania it forms rough ridges, with a poor sandy soil. It is used for glass-making, and contains an iron-ore too silicious to be valuable. Some of our geologists (Hall, Rogers, Dana, etc.) place the Oriskany at the top of the Silurian series, and others (Newberry, Lesley, Hunt, etc.) at the bottom of the Devonian.

9-12. DEVONIAN AGE.

9. LOWER DEVONIAN.

9 Upper Helderberg or Corniferous.—This very widely extended formation consists of four important members, the Cauda-galli, the Schoharie grit, the Onondaga limestone, and the Corniferous limestone, the upper member. But in the recent text-books on geology the whole formation is called the Corniferous, which was the name given by Eaton to the whole formation of limestone. It forms the Helderberg range, a high ridge which extends through the State of New York, forming a very rich and productive tract of country. This group of strata, as above limited, and designated the Upper Helderberg by Professor James Hall, is, in his opinion, deserving of recognition as the base of the Devonian, the Hamilton group being the middle, and the Portage, Chemung and Catskill the Upper Devonian.

9 a. Cauda-galli.—This is a fine-grained calcareous and argillaceous sandstone, usually drab and brownish, and blanching by long weathering. It readily strikes the eye by its contrast with its associated rocks, and by the singular marking of impressions strongly resembling the tail of the common barn-yard fowl, from whence its Latin name of Cauda-galli or cock's-tail. Its fossils have been found in New York and at Crab Orchard, in Kentucky. In New Jersey, northeast of the Delaware-Water Gap, this and the Schoharie are three hundred feet thick.

9 b. Schoharie Grit.—This is very much like the preceding, but altogether different in its fossils. It is a fine-grained, very calcareous grit, or an arenaceous limestone, naturally brown, but weathering to a gray or drab color, containing a great number of fossils peculiar to this stratum, and is found in the mountain one and one-half miles northwest and northeast of Schoharie, New York, and extends by the Helderberg range to Kingston. The Schoharie Grit is a highly fossiliferous formation, and has a wide geographical extension. Its great number of cephalopods gives it a marked character, but it contains other fossils identical with the limestones above.—H.

The **9 c. Onondaga Limestone** in New York rarely exceeds ten to fourteen feet in thickness, but is very persistent, and is readily recognized by its light gray color, crystalline structure, toughness, and its numerous organic remains. This is one of the most valuable building stones in the Helderberg division, and has been largely quarried near Syracuse for the canal. It is an imperishable stone, having great power to resist the action of air, water and frost. It is generally the rock over which the water flows at the water-falls on the Helderberg range, as at Perryville and Chittenango Falls, and is remarkably uniform in its character. It is more extensive than the Corniferous proper, and it is very rich in beautiful and characteristic fossils. The limestones used for flagging in Syracuse are Onondaga limestone, brought from the typical localities Onondaga Valley and Split-Rock on Onondaga Hill. When wet they make a fine display of fossils of this formation. This stone is also used for building everywhere in Central New York.

9 d. Corniferous Limestone.—For all practical purposes, this and the Onondaga limestone may be regarded as one formation. It extends from the Hudson River to the Niagara River, which it crosses at Black Rock, producing there a rapid current at the International Bridge, at Buffalo, and forming a small island just above the water. It extends far into Canada, is seen at Sandusky City, Ohio, and there forms the bottom of Lake Erie. Its color varies from a light grayish-blue to a black, and is sometimes even a light gray or drab. It contains numerous nodules of flint or hornstone, from which it derives its name. But few if any of the layers afford a pure limestone. Its color varies from black to gray, brownish and light blue. It is usually in regular courses from six to eighteen inches thick, separated by layers of hornstone, and sometimes embracing flattened nodules of the same. This rock is crossed by vertical joints in two directions, giving rise to numerous copious springs of water. An upper division, called the Seneca limestone, is now included in the Corniferous. In New Jersey and Pennsylvania it is a blue and sometimes sparry limestone, including bands and nodules of chert. In Canada and the Western States it is a straw-colored and light gray rock. In its general eastern exposures it is generally bluish. Above the Corniferous are no general limestone masses in the Eastern States, but partial deposits only, the most extensive of which is the Tully limestone, found only in Central New York. There is an astonishing change from the top of the Corniferous limestone to the black shales of Marcellus. Two formations more unlike cannot anywhere be found. Both the Corniferous and Onondaga are included in the Upper Helderberg limestone of Pennsylvania, and on the Juniata they measure together only sixty feet. Immediately upon the upper surface of the Corniferous limestone, lies the valuable and extensive MARCELLUS IRON ORE. This consists of carbonate of iron, which occurs in a bed of pyritous clay, and near the outcrop is changed into limonite.

10. MIDDLE DEVONIAN.

10 a. Marcellus Shales are of a black color, usually dark brown when altered. They greatly resemble the Utica slate in mineral character, and could readily be mistaken for it. They extend in New York from the Hudson River to Lake Erie. The lower part contains some impure black limestone, not in layers or beds, but in interrupted flattened masses. The upper shales are not so highly colored as the lower ones, and are disposed to separate, when long exposed, into small, thin-edged fragments, the result of a peculiar accretionary structure. The fragments often exhibit stains, in spots, from iron rust, and also minute crystals of gypsum, the effect of the action of decomposed pyrites and limestone particles. Some portions of the lower shales are black and friable from small carbonaceous fucoids. Along the whole line of its outcrop it has been dug into in vain attempts to find coal.—Van U. 147. It has two joint planes, nearly at right angles to each other, causing projecting corners of rock, with smooth nearly vertical surfaces. These are sometimes seen in the upper members also of the Hamilton group, and the *septaria* or flattened balls of black limestone also occur in the Genesee shales.

The lower part is very black, slaty and bituminous, and contains iron pyrites in great profusion. In general character the lower part resembles the Utica slate and is not distinguishable from the 10 c. Genesee slate, in its general aspect. When long exposed, the lower part weathers to a brownish or iron-rust color, partly from the presence and decomposition of iron pyrites and partly from bituminous matter. In some situations it retains its purely black color, and scarcely separates

into thin laminae after long exposure. In many places this rock contains so much bitumen as to give out flame when thrown upon a fire of hot coals. In Western New York it is fifty feet thick, and farther east much thicker.—H.

This important formation carries its broad black outcrops across many of the Middle and Southern States, with comparatively little change, but in the South the black shale is supposed to be Genesee. In the Juniata region of Pennsylvania the Marcellus has been found to measure 875 feet thick, and is there divisible into an upper, middle and lower member, the last consisting of black and brown shales, the surface being stained with iron rust, &c., coated with bituminous matter. In Perry County, Pennsylvania, small coal beds occur in this formation, constituting the oldest known coal-measures, and significantly marking the great change in the general condition of things which either followed or was introduced by the deposit of the Oriskany sandstone.—Lesley.

In speculating upon the origin of petroleum, some geologists have sought it in a process of distillation from the black Marcellus and Genesee shales upward, and of condensation in the oil-bearing gravels and fissures of the overlying formations. Chemists, like T. Sterry Hunt, oppose this view on chemical grounds, others oppose it from other considerations of apparently equal weight. It is a curious fact, however, that at this horizon, and in the Upper Helderberg or Corniferous, occur the petroleum deposits of Upper Canada, while the Pennsylvania oil-deposits lie at successively higher and higher stages in the series.

10 b. Hamilton.—This group takes its name from the town of Hamilton, in Madison County, New York, which contains no other rock, and where the best opportunity exists of examining the members of which it is composed, and where its fossils are in great abundance. It includes all the masses between the upper shales of Marcellus, and the Tully limestone, and is from 300 to 700 feet in thickness in New York. It is important from its fine agricultural qualities, its thickness and extent, commencing at the Hudson and extending to Lake Erie. It consists of slate, shale and sandstone, with endless mixtures of these materials, or, in other words, sandy shale and shaly sandstones, and is not very easily described. There are three distinct mineral masses as to kinds, but not as to arrangement. The first, in the order of the tenuity of particles, is rather a fine grained shale, often fissile or slaty, its color some shade of blue, usually dark or blackish. The second is a coarse shale, often mixed with carbonate of lime, its color blue or dark gray when fresh, but becoming of an olive or brown color by long exposure to the weather, the color being due to manganese. It has no tendency whatever to separate into regular layers, but when a mass has been long exposed it shows numerous curved divisions, the curves very short and irregular, giving it a very peculiar appearance, which is unmistakable. The third kind, which is not so common as the two first, is a well characterized sandstone, and is generally in the upper part of the group, but more or less mixed with either of the two others. It is often in layers, though rarely straight, and usually short, interrupted, sometimes mixed with carbonate of lime. The colors of this kind are of more various shades, olive, greenish and yellowish. One thin layer produces excellent flagstones, but the group generally is deficient in building materials, the shale of the first kind readily crumbling by exposure to the air; the two latter kinds alone furnishing building stone. The best is where limestone forms the cement, and sand is in the

greatest abundance. So rare is the occurrence of regular layers in the group, that their absence is a good negative character, and its brownish or yellowish color, externally, or where weathered, a good positive one of the group generally. This applies to the central, but not to the eastern part of the State of New York. It abounds in fossils, and is admirably characterized by them, numerous species and even genera commencing with the group, and ending with it.—Van U. 150.

In the western part of the State of New York, instead of sandy shale and shaly sandstone, and even tolerably pure sandstone, as in the east, the sand has diminished and the clay increased. The group, as a whole, presents an immense development of dull olive, bluish-gray calcareous shales, which, on weathering, assume a light gray or ashen tint, some thin portions becoming brownish on exposure. The formation thins out very much in going westward, and at Lake Erie has only half the thickness found at Seneca Lake, and is so different that doubt of the identity of the two might arise, if one judged by the appearance only. The Hamilton is the New York lake formation, the following lakes being excavated in it: Otsego, Cazenovia, Skaneateles, Otisco, Owasco, Cayuga, Seneca, Canandaigua, and the north end of Hemlock Lake. The east end of Lake Erie is also cut out of the Hamilton. The upper part of the Hamilton was called the Moscow shale, from a place between Mt. Morris and Rochester, on the Genesee River.

In Pennsylvania the Hamilton shale has been measured on the Juniata, 635 feet thick. It has many hundreds of miles of outcrop, in repeated zig-zags, forming, in combination with the Genesee and Portage above it, ranges of smooth, cultivated hills, of an entirely characteristic shape, in long lines of ruffled slopes, regularly indented with short and smooth ravines. This striking topographical feature, maintains itself throughout the mountain-region into Virginia, and still farther south. The abundance of shells, without limestone beds, in Pennsylvania, furnishes a partial clue to the deposit of the (next succeeding) Tully limestone in New York.

10 b. Tully Limestone.—This is the dividing line, easy to find, between the Hamilton and Genesee, being the upper part of the former, and it is important in New York as the most southern mass of limestone in the State. It is only local, and is an impure limestone, fine-grained, usually a dark or blackish blue, often brownish. The usual thickness of the rock is about fourteen feet, and its greatest thickness twenty feet. It makes a good but not a white lime. It receives its name from the township of Tully, in Onondaga County, New York. This limestone often shows an accretionary structure, and a roughed, notched appearance, where its layers separate as in some of the layers of the water-lime. One of the lower layers is thick, the bottom one being frequently five feet in thickness, and it is owing to this circumstance, and to the softness of the shale beneath, that whenever a waterfall exists, the shale has been washed out to some depth, leaving a chamber or cavern, of which the limestone forms the roof or ceiling.—V. 169. It is a marked geological horizon in Central New York, being the termination of the Hamilton, and is succeeded by shales of a widely different character. It is often thick-bedded, but it is often divided by numerous irregular seams into small fragments. Its color, on first exposure, is blue or nearly black, but weathers to an ashen hue. It is best seen on the Cayuga Southern R. R., where it stands out in the face of the cliffs as a prominent band. It is absent west of Canandaigua Lake and in the eastern part of the state.—H. 212.

10 c. Genesee, (Black Slate of the west and south).—This is a great development of argillaceous fissile black slate. Where its edges only are exposed, it withstands the weather for a great length of time, and often presents mural banks in the ravines, river-courses, and upon the shores of lakes. When the surface of the strata is exposed it rapidly exfoliates in thin even laminae. On disintegration it is often stained with iron, owing to decomposition of pyrites, but in many instances, and the greater number of localities, it retains a deep black color. In this it is distinguished from some beds of black slate in higher situations, which always become stained with hydrate of iron on their edges, and upon the surface of the laminae. In color and general character it greatly resembles the Marcellus shale, and, aside from position, it would be difficult to distinguish the two, in the absence of fossils. It forms no conspicuous feature in the scenery or topography of the general surface. In ravines, and river and lake banks, it is usually seen in connection with the rocks below or above. Its greatest development, and a point where it appears more prominently alone, and the typical locality from which it was named, is at the opening of the gorge of the Genesee, at Mount Morris, where it is seen in the perpendicular cliffs for more than a mile in length. See note No. 112, New York. Another great exposure of the Genesee slate is along the Cayuga Southern Railway south of Ludlowville, where it shows from eighty to one hundred feet thick, with the Tully limestone below and the Portage shales above it. See note 83, New York. The mass decomposes much less rapidly than the soft calcareous Hamilton or Moscow shales below it, and the thin slaty laminae resist atmospheric action a long time. In lithological character it is entirely uniform, having, from Cayuga Lake to Lake Erie, the same deep black color and laminated slaty structure, nor is there any change in its organic remains. Its fossils in Indiana are precisely identical with those of New York.—Hall 218.

There are few formations in Central New York of which the limits are so well defined as this, lying between the Tully limestone below, and the sandstone flags of the base of the Portage group, above. It may also readily be found by the black color and slaty fracture. This shale has been regarded as the main original source of the petroleum in the oil region of Ohio and Western Pennsylvania, but there is reason to believe that part, at least, of the supply of these regions has come from the Corniferous limestone below it, as maintained by Dr. Hunt.

All through the western and southwestern states there is always found a **BLACK SHALE**, which is often the only representative of the Devonian rocks. This is generally considered to be 10 c. Genesee. It is very remarkable that a formation of its composition, of so inconsiderable a thickness, and otherwise so unimportant, should be so widely extended, and retain throughout its character unchanged as a black shale. The researches of Dr. Newberry in Ohio tend to show its fossils to be of the Portage type. It is there 350 feet thick, and he pronounces it to be the equivalent of the Genesee and lower Portage. All the divisions of the Hamilton group, Marcellus, Hamilton and Genesee, are converted, by exposure, into a deep soil of an excellent quality for agricultural purposes, sometimes quite hilly, but forming smooth land free from stones. Some of the finest wheat-growing and hop-raising land in New York is on the Hamilton, and its rich shales have been carried south by drift and diluvial agencies, and spread over the Genesee, Portage and Chemung, greatly to their improvement.

11-12. UPPER DEVONIAN.

11 a. **Portage.**—This group represents an extensive development of shales and flagstones, and finally some thick-bedded sandstone towards its upper part. It is extremely variable in character at different and distant points. In New York the Portage rises sometimes in a gentle slope, and at other times abruptly from the softer shales below. Between the deep north and south valleys, in which the railroads run, the enduring sandstones of the upper part extend far northward, presenting, on the north side, a gentle slope, while on the east and west sides of the same hills, the slope is abrupt, the valleys being bounded by steep hills. *The change in the external appearance of the country indicates the commencement of these Portage rocks, although they are not seen.* Throughout the Hamilton shales, the valleys present gently sloping sides, and the country rarely rises far above the valley bottom. But on approaching the northern margin of the Portage group, the railway traveler sees a gradually increasing elevation of the hills on either side, and an abruptness in their slope, and in a short time finds himself in a deep valley bounded on either side by hills rising 400 or 500 feet, and in some instances, even 800 feet above the bed of the stream. These elevations often extend several miles unbroken, except by the deep ravines which indent their sides. The higher sandstones of the group, and in many instances the intermediate ones, produce falls in the streams which pass over them, and some of the most beautiful cascades in the State of New York, and many of the highest perpendicular falls of water, are produced by the rocks of this group, and in none others do we meet with more grand and striking scenery.—J. Hall's Report.

The pedestrian often finds his course impeded by a gorge of several hundred feet in depth, such as Watkins Glen and Havana Glen. The Portage upper, middle and lower falls are 66, 110 and 96 feet, and between the middle and lower the rocks rise in perpendicular cliffs 351 feet in height. See note No. 110, New York, as to Portage on Erie Railroad. Taghanic, Hector, and Lodi falls are also in the Portage. These points afford some of the grandest views of scenery, and admirable facilities for geological investigations. The lower division of the Portage is the 1. *Chasagua shales*, a green shale, with thin flagstones, and sandy shale. 2. The middle portion is the *Gardeau shale* and flagstones, a great development of green and black slaty and sandy shales, with thin layers of sandstone, from which are quarried beautiful and durable flagstones. The rocks of this part of the group form high, almost perpendicular, banks on the Genesee. In a westerly direction the sandstones disappear, and the shales increase. 3. The upper part of the Portage consists of the *Portage* sandstones, thick bedded sandstones, with little shale, while below, the sandy layers become thinner, and shale beds more frequent; still it must be acknowledged that there is no abrupt change from the beginning of the Portage to the top of the Chemung. In the Portage, the sandstones and shales are less separated than above, and the sandy strata are finer grained, and contain more lime than in the Chemung. Towards the southern extremity of Cayuga and Seneca Lakes, the Portage rocks form cliffs of considerable height, which present alternating hard and soft layers, and the numerous vertical joints present the appearance of solid walls of masonry, in distinct and regular courses. The vertical joints are well seen in Havana Glen. Isolated masses, like huge columns, are often seen, standing out in bold relief from the line of the cliff, being the remains of previously exposed surfaces, which

had crumbled away. On the Genesee River the group is not less than 1000 feet thick. The Portage yields less lime to the soil than the Hamilton, but for pasturage it is superior to it.—H. 224. The great dairy-country of Cortland, and other counties in Central New York, is on the Portage formation. The water of the Portage group is remarkably pure and soft. The Portage rocks have not been recognized in the eastern part of New York. In Ohio the Portage forms the upper part of the Huron shale, and the lower part of the Erie shale, of Dr. Newberry.

In Middle Pennsylvania, according to Lesley, the Portage flags are 1,450 feet thick, and the Chemung shales over them, 1,860 feet thick. It is very hard to draw a line of demarcation between them, but, as a whole, the Chemung strata are more silicious and the Portage more argillaceous. The Portage sandstones are flaggy, and, at times, very shaly, and their alternations with shale frequent, the individual beds being thin, and the shales predominant. The Chemung sandstones are more massive, ferruginous and micaceous, with fewer alternations of shale. Brachiopods and other shells are abundant in the upper Chemung shales, while the Portage rocks are almost destitute of animal forms except crinoids and fucoids. Fucoidal impressions are also very abundant in the upper Chemung, and to the decomposition of this abundant marine vegetation, Lesquereux and others ascribe the origin of the petroleum, at its various local horizons, from the Portage up to the Mahoning sandstone in the Coal Measures.

11 b. Chemung.—These rocks can everywhere be described as a series of thin-bedded sandstones and flagstones, with intervening shales, and mixtures in various proportions of these, and very rarely beds of impure limestone, resulting from the aggregation of organic remains. The whole series weathers to a brownish olive, and even the deeper green of the shales assumes that hue. The shales vary in color from a deep black to olive and green, with every grade and mixture of these. The sandstones are often brownish-gray or olive, and sometimes light gray. More generally, however, there is a tinge of green or olive pervading these strata. Towards the upper part of the group, in some localities, there is a tendency to conglomerate, and in a few places the mass becomes a well defined pudding-stone, with sometimes 150 to 200 feet of Chemung shales and sandstones above it. Towards the upper part of the group the shales are reddish, coarse and fissile, with much mica in small glimmering scales.—Hall 251. From their red color these have sometimes been mistaken for the Catskill formation.

In a few localities in Pennsylvania it contains a very excellent variety of iron ore. As a general thing, however, this formation, and all others above it, up to near the coal conglomerate, are singularly deficient in iron ore. There is little of geological interest throughout the whole extent of the Chemung group. The N. Y. L. E. & W., or Erie Railway, runs for 300 miles west of Susquehanna on this formation, and on nearly the same portion of it. In the northwestern portion of Pennsylvania the celebrated oil region is in the Chemung, the oil being found stored-up in certain coarse porous sandstones, but these are merely the repository of the oil originating in lower strata. It is a very extensive formation in Southern New York, all the southern tier of counties, west of Great Bend, being covered by it, and it forms an excellent grazing and agricultural country, not quite equal to the Portage, but much superior to the Catskill. In Northern Pennsylvania this formation, as in Southern New York, consists of a vast succession of thin layers of shale, of every hue, from a deep olive and dark green to a light slaty gray, alternating with thin beds of brownish gray sandstones.

In Pennsylvania, ninety feet of strata have been carefully studied and measured on Sideling Hill, consisting of alternate beds of red and olive shales and sandstones with Chemung fossils, ripple-marks and fucoids, and a bed of iron ore long known by the name of the Larry's Creek ore, which outcrops everywhere along the face of the Allegheny Mountain. In the gaps at Blairsville and Connellsville, in Southwestern Pennsylvania, Prof. Stevenson finds Chemung fossils in what have always been called the Catskill rocks, on account of their being of a red color, and other geologists have made the same observation in Northern Pennsylvania. In Southern New York, adjacent to Pennsylvania, Professor Hall reports 150 feet of red rocks, and then thin gray rocks above with Chemung fossils.

The Erie shale of Ohio is the equivalent of the 11 b. Chemung, and the upper part of the 11 a. Portage. At Cleveland, it consists of green, gray and blue shales—soft and fine, with sheets of micaceous, silvery sandstone, from half an inch to two inches in thickness, and flattened masses of argillaceous iron ore.—Newberry. The formation also occurs in Kentucky, and Chemung fossils have been found in Utah and Nevada by Clarence King and Arnold Hague.

12. Catskill.—There is no observable line of demarcation between the Chemung and Catskill. The first sign of change is a more solid or hard rock appearing, often accompanied by red sandstone or red shale. The group consists of light colored gray sandstone, usually hard; of fine-grained red sandstone, red shale or slate; of dark colored slate and shale, of grindstone-grit, and a peculiarly accretionary and fragmentary mass, appearing like fragments of hard slate cemented by limestone, similar to what is well known in England as corntone. The hard gray sandstone often presents a highly characteristic structure, the layers, one or more inches thick, being disposed in oblique divisions, the divisions usually overlapping each other. This peculiar angular arrangement presents altogether a singular conformation, and forms a highly picturesque rock.—V. You can see this at Ralston, Pennsylvania.

The prevailing color of the sandstone is brick-red, though often it is lighter, and sometimes of a deeper color, from a larger proportion of iron, while the coarser parts are often gray, and the shales are green. Beds of green shaly sandstone are interstratified with the red friable sandstone, and these are succeeded by a compact kind of conglomerate rock. The formation expands, and augments in thickness, in passing eastward, till it finally rises in the high and prominent peaks of the Catskill Mountain, nearly 4,000 feet above the sea, from which the formation derives its name. See note No. 9, of New York.

The formation extends from this locality southwestward into Pennsylvania, where its outcrop, 3,000 feet thick, in combination with that of the Pocono sandstone above it, 2,000 feet thick, forms a terraced mountain, which surrounds each of the Anthracite coal fields; the red rocks of the Catskill making the terrace, and the white rocks of the Pocono forming the crest. Piled upon one another in inclined strata, they constitute the bulk of the Catskill Mountains in New York, of the Pocono plateau in Pennsylvania, and the Allegheny, Savage and Cumberland Mountains, far into Virginia and Tennessee.

On all the railroads approaching the anthracite coal regions of Pennsylvania one passes over these Catskill rocks, often for many miles. They contain no coal, but fossil ferns are abundant in some localities. This is the last and upper formation of the Devonian period, and is the foundation on which rests the carboniferous

system. On the Delaware division of the N. Y. L. E. & W., or Erie Railway, is an opportunity of seeing the red rocks of the Catskill formation for a number of miles, and also on the N. Y. & O. Midland Railroad north of the Bloomingburgh tunnel.

In Pennsylvania it is composed of a vast succession of thin-bedded red and gray sandstones, with thin seams of red, green and mottled shales, also coarse and fine sandstones of various hues of red, brown, gray and greenish; together with red and greenish coarse silicious conglomerate of white quartz pebbles, the whole being thick bedded, and with an oblique laminated structure. It has not much of interest, either to the scientific or practical inquirer. Its most interesting fossils are fish-remains, which, in the Catskills, extend through 100 feet in thickness of strata. It is the *Old Red sandstone* of England, lying under the coal. The English *New Red sandstone* is over the coal, being the Permian, Jurassic and Triassic formations, but these are not found directly over the coal in America.

The Catskill formation is a poor one for agricultural purposes. The fields are stony, with many projecting ledges of red rocks. Its sandstones are too hard, and too destitute of lime to produce a fertile soil, and the country covered by it is either a wilderness, or very thinly populated.

13-15 CARBONIFEROUS AGE.

13 a. Lower Sub-Carboniferous.—To a superficial observer, the remarkable substitution of great sandstone and conglomerate deposits, under the coal-measures in the east, for generally limestone deposits, under the coal-measures of the west, must seem inexplicable. But the simple explanation is, that all the sub-carboniferous sand-beds of Pennsylvania, formed near the old continent, thin away, and gradually disappear, before they reach the Mississippi; while the five great sub-carboniferous limestones of Illinois, Iowa, and Missouri, formed in a deep quiet sea, on the contrary, thin away, in going eastward, to 40 feet in Westmoreland County, and 25 feet in Somerset County, Pennsylvania; and totally disappear before reaching the Schuylkill and Lehigh Rivers. But the same limestone deposits thicken southward to 600 and 1,000 feet in Virginia, and even more in Tennessee.

In the Pennsylvania Anthracite country, the next formation above the Catskill is a gray sandstone, called by Prof. H. D. Rodgers the Vespertine. In the second geological survey, Prof. Lesley calls it the Pocono, from the name of the mountain bounding Wyoming Valley, on the south side. The miners call it the second conglomerate. It contains carboniferous fossils, but no coal of value. Invariably the Vespertine is the outside mountain surrounding the coal-basins, the inside one being the 14 a. Pottsville conglomerate, or Millstone grit, and they are separated by 13 b. Mauch Chunk red shale, of Lesley, or Umbral, of Rogers, a soft rock, which forms a valley; and all four, 12. Catskill or Ponent, 13 a. Vespertine or Pocono, 13 b. Umbral or Mauch Chunk, and 14 a. Seral or Pottsville conglomerate, are worthless for farming purposes.

In Pennsylvania, the Vespertine is a white, gray and yellowish sandstone, alternating with coarse silicious conglomerates, and dark-blue, olive and black slates, and occasionally thin beds of coal. In Michigan, it is the Marshall group, which is mostly a somewhat friable rock, with a reddish, buffish, or olive color, though in some regions becoming gray or bluish-gray. It forms the receptacle into which the brine descends, and accumulates from the next over-lying Michigan salt group, which is 13 b., and also sub-carboniferous. The Waverly group of Ohio is proved, by its fossils, to be of this same age. Its sub-divisions are given at the head of the chapter on Ohio. It produces the Berea grindstones and Waverly sandstone, the finest building-stone in Ohio, if not in the United States. In Tennessee there is a great development of the lower sub-carboniferous group, the 13 a. Barren group, and 13 b. Coral, or St. Louis limestone, formerly called by Prof. Safford the Silicious. Its upper part is the equivalent of the St. Louis limestone of Missouri; the lower is a series of silico-calcareous rocks, characterized by heavy layers of chert, one inch to two feet thick.

In Illinois the series of sub-carboniferous strata consists of the 1. Kinderhook group, 2. Burlington group, 3. Keokuk group, 4. St. Louis group, the base of which was formerly called the Warsaw limestone, and the 5. Chester group; all of these are limestones and shale, with some sandstone in the first and last named. These embrace both the lower and upper sub-carboniferous, and are 1,200 to 1,500 feet thick in the south-western part of Illinois, but thin-out in going north, and entirely disappear before reaching Rock Island, where the coal-measures rest on the Devonian limestone. In Iowa the four lower members occur, but the Chester, the thickest member, is wanting, and it is almost entirely wanting in Missouri.

In Pennsylvania a small coal-bed has been opened on the Susquehanna River, in the Pocono sandstone; and in Huntingdon County more than a dozen small layers of coal may be traced, running through the formation. In Montgomery County, Virginia, two similar coal-beds attain a local importance, being on Tom's Creek, respectively 4 and 8 feet thick. These represent the lower coal of East Kentucky, Tennessee, and Alabama.

In Ohio the Subcarboniferous limestone extends through some of the southeastern counties. It is quite thin, and represents only the upper or Chester member of the group. Two workable seams of coal—the Jackson and Wallston coals—are found below it.—Newberry.

13 b. Upper Sub-Carboniferous.—In Pennsylvania this is the Umbral red shale of Rogers, and the Mauch Chunk of Lesley, sometimes 3,000 feet thick, and here consists almost entirely of very soft red shales and argillaceous red sandstone, without fossils. It gradually becomes in Virginia a triple mass of buff, green and red shales below, a thick body of light-blue limestone, full of fossils, in the middle, and the upper part blue, olive and red calcareous shales, with massive strata of gray and brownish sandstone. It contains beds of iron ore, which are sometimes very valuable. In the Western States the limestone is the principal rock. It is the limestone of Greenbriar Valley in West Virginia. In Northern Pennsylvania, gray and greenish shales, and gray argillaceous sandstones, are introduced among the red shales, and farther west it consists of two or more strata of soft red shales, separated by a thick body of gray, flaggy sandstone. It is generally well marked in Pennsylvania as the softest of rocks, or simply dry red mud, and is to be noticed by those in search of coal, none of which is ever found in or below it. In Tennessee this formation is the mountain limestone,

beneath the coal-measures. It is a heavy body of limestones and shale, the latter almost one-fourth of the mass; and there is also a sandstone. See the above description of 13 a. in Illinois.

In Middle Pennsylvania, around the Broad Top coal-basin, Prof. J. P. Lesley says there appears, for the first time in this formation, going west, distinct traces of the great mountain limestone formation, which underlies all the southern and western coal-fields, and becomes one of the principal features of the geology of the Rocky Mountains, as it is also of the geology of Europe. The red shale formation is here seen, divided in two—910 feet of it above, and 141 feet of it below; a middle group of red and gray, mottled calcareous shales, and thin limestone layers, full of fossil shells—in all 49 feet thick—separating the upper and lower members of nearly pure red shale.

The narrow red shale valleys, which surround this Broad Top coal-basin, the Cumberland basin in Maryland, and the three principal groups of anthracite basins in Eastern Pennsylvania, are due to the thickness and softness of this important formation. But while it is 8,000 feet thick at Pottsville, it is but 300 feet thick along the Allegheny Mountain, and less than 100 feet thick around the coal-basins of Tioga and Bradford counties; and, therefore, instead of making valleys, only marks the top of the mountain steep slopes with a narrow terrace, over which dominates the vertical cliffs of the outcrop of the coal conglomerate.

14 a. Millstone Grit.—This is a mass of white or yellow sandstone, containing vast numbers of quartz pebbles, and forming a pudding-stone, or conglomerate. It is called the Millstone Grit, from being used for the manufacture of millstones. In Pennsylvania and Virginia the formation is 1,000 feet thick, but becomes reduced to from 10 to 175 feet in Ohio. In Kentucky it is from 50 to 500, and in Indiana from 50 to 100 feet. It is a very peculiar rock, and very wide spread, extending out beyond the coal measures proper, of which it is the base and support. There is not in the entire geological series, says Dr. Newberry, another stratum of rock so widely distributed, and presenting as strongly marked lithological characters, as this. The pebbles are generally of quartz, and well rounded. The sand, which forms the paste, and holds together the pebbles of the conglomerate, is generally coarse, and consists of rounded grains of quartz, which differ from the pebbles only in size. In the anthracite region of Pennsylvania, conglomerate rocks sometimes occur between coal-beds, but in the other coal regions they are below all the workable coal-beds. Any cases of thin beds of good coal being found in or below the conglomerate, are exceptional and rare. It does not always maintain its character as a conglomerate, being sometimes an ordinary sandstone. The great lead mines of Joplin and Granby, in Missouri, are in a ferruginous sandstone, the equivalent of the Millstone Grit, or the Chester group, and the Hot Springs of Arkansas are in the Millstone Grit, greatly metamorphosed.

14 b. and c. Lower and Upper Coal Measures.—The series of rock-strata, among which the carboniferous coal-beds are found, are called the Coal Measures, which produce all the best coal of America. They consist of repeated alternations of exceedingly diversified rocks, of every degree of coarseness, from the smoothest fire-clay to exceedingly rough, silicious conglomerates, including within those extremes a wide variety of coal-shales, or mud-rocks, of almost every color and texture—marls, argillaceous sandstones and quartzose grits, also thin bands of limestones, both pure and magnesian, and numerous seams of carbonate of iron.

The numerous coal-beds themselves, which occur among this series of strata, the most interesting and important of them all, are also found in America in all their known varieties, from the most compact anthracite to the most fusible and bituminous kinds of coal. There is no invariable order for the strata of coal measures, but usually the bed of coal has a fire-clay bed below it, and shale immediately over it. Extending our view over a considerable district, we find these rocks are coarser and more massive towards the east or south-east; that they become more fine-grained, and less sandy and earthy, and the limestones increase in size and number as we proceed westward or north-westward; that many of the strata become reduced in thickness, and some of them entirely disappear. In Pennsylvania and Ohio the middle portion of the coal measures contains no coal seams, and hence is called the Barren Measures, thus dividing the formation into Upper and Lower Productive Coal Measures. The Lower Coal Measures sometimes contain valuable beds of iron ore. Salt is produced from the Lower Coal Measures in Western Pennsylvania, Virginia, Ohio, Indiana, Illinois, and Kentucky.*

15. Permian.—On the Kansas Pacific, and on the Missouri, Kansas & Texas Railroads, several stations are given in Western Kansas, in the annexed Guide, as being on the Permian formation, which is found in America only in this locality. The Permian rocks, according to Dana, are limestones, sandstones, red, greenish, and gray marlites or shales, gypsum beds and conglomerates, among which the limestones, in some regions, predominate. In Kansas they consist, according to Prof. Mudge, of calcareous and arenaceous shales and beds of limestone. The latter are quite impure, but sometimes massive magnesian limestone, of a drab and buff color, is found, which furnishes an excellent building material. Prof. Swallow describes them as a series of limestones, marls, shales, sandstones, conglomerates, and gypsums. The State capitol of Kansas, at Topeka, is built of Junction City limestone of the Permian formation. It is also used at Manhattan, and the buildings at Fort Riley are also conspicuous specimens of Permian limestone. The rocks here called Permian, are conformable to the coal-measures, and contain many coal-measure fossils, with some not found below. Some geologists think there is no good reason for separating them from the Carboniferous system, of which they form the upper member. Strata of the same age occur in Indiana, Texas, and Mexico, where they contain many new and interesting reptilian remains. In most parts of the United States, however, the coal-measures are not overlaid by these so-called Permian or Permo-Carboniferous beds, either because they were never deposited, or have been removed by erosion. One of the remarkable facts in American geology is the extremely small extent of the Permian and Jurassic groups of formations in the eastern half of the continent. The Permian forms part of the New Red Sandstone of England, lying over the coal. The name is derived from *Permia*, a province in Russia.

* Having been for twenty-one years actively engaged in mining, transporting and selling coal, the author's business led him to the study of geology, particularly in its economic bearings, and he has given to the world all he knows about coal in another work entitled, "THE COAL REGIONS OF AMERICA: THEIR TOPOGRAPHY, GEOLOGY, AND DEVELOPMENT," with a colored geological map of Pennsylvania, a railroad map of all the coal regions, and numerous other maps and illustrations. By James Macfarlane, Ph. D. One 8vo. volume of 700 pages. Price, in cloth, \$5; in sheep, \$6. Published and for sale by D. Appleton & Co., New York.

15-18. MESOZOIC.

16. Triassic.—As the railroads from Philadelphia to New York, the greatest lines of travel in this country, run on this formation, it is the most conspicuous and well known in the State of New Jersey, and one in which geologists are now taking great interest. Every observing person must have noticed it, and its aspect and composition are so uniform and well marked, that a description of it here will answer for the whole belt through the States of Pennsylvania, Maryland, Virginia, and North Carolina, from the Hudson River to Deep River, in the latter State, and in the Connecticut Valley.

The Triassic consists of dark reddish-brown sandstone, soft, crumbly brown shales, and the upper beds are coarse conglomerates. The almost invariable dip is towards the north-west, at angles ranging from 15° to 25°. Prof. H. D. Rogers thought this uniform dip was not caused by any uplifting agency, but that the rocks were originally laid down in this manner. His theory is that the formation owes its origin to an extensive ancient river, having its source at the eastern base of the Blue Ridge, in North Carolina. Following the remnants of the Triassic formation thence north-east, it gradually, from small beginnings, becomes larger, and has throughout a descending course. At the James River, it is four, at the Potomac six, at the Susquehanna twelve, and at the Delaware, thirty miles wide—the estuary being in the region of the Raritan and the Hudson. In New Jersey, therefore, this river was at its maximum.

The uniform dip was supposed by Prof. H. D. Rogers to be the result of the oblique or slanting mode in which the sediment has been laid down by a rapid and steady current washing the material from the south-east side or shore of the river. If it were due to an upheaval, this formation, measured in the usual way, would show an unheard-of thickness. In fact, it is very thin, as is shown in the exposures of limestone in the interior of the belt. All the appearances of the formation indicate, and there is much to sustain his opinion, that it never was tilted.

But more recent study of this interesting formation, has proven two facts: (1) that it was originally extensive, far beyond its present limits; and, (2) that, in at least its middle beds, the original deposits were horizontal, and have been since upturned. The two great belts of Triassic, which cross from Virginia into North Carolina, and one of them into South Carolina, not only have their rocks dipping in opposite directions, showing a long and broad uplifted country between Raleigh and Danville; but certain groups of coal-beds, which, though now dipping in contrary directions, must of course have been originally horizontal. Traces of coal-beds have been found in the Triassic of Pennsylvania, in York county, and at Phoenixville. The intermediate country in North Carolina was, therefore, presumably once covered with the formation, and probably all Virginia, east of the Blue Ridge, and all south-eastern Pennsylvania. The formation is seen passing under the plastic clays of New Jersey, and may extend far under the bed of the Atlantic, being thus connected with the beds of the Connecticut, and even those of the Bay of Fundy.—Lesley.

Relics of vegetation are occasionally found in the Triassic, in the form of highly compact and bituminous lignite, the longitudinal sections exhibiting the fibrous structure of the wood, whence it was formed. This lignite, occurring sometimes in seams of two or three inches in thickness, amid dark shales, has been a fertile source of delusion, some persons having been induced by the hope of finding valuable coal-mines, to waste much labor in the search. Although the Richmond and North Carolina coals are Triassic, all the geological facts discountenance the notion that it contains coal in New Jersey and Pennsylvania, the detached fragments of plants, which we meet with in the form of lignite, having evidently been loosely drifted into these sediments from the land. Prof. Emmons says there is nothing which can be regarded as equivalent to the coal measures of the Chatham (N. C.) and Richmond (Va.) series in the northern beds. All this formation was produced at a period subsequent to the great Carboniferous or coal-bearing rocks. There are great numbers of fossil fish in the Trias of New Jersey and Connecticut valleys, among them twenty species of *ganoids*; also the famous bird-tracks of Dr. Hitchcock. See notes 7 and 8 on Massachusetts. Fossil plants are numerous in the Trias of Virginia and North Carolina.

When a large portion of the pebbles are of limestone, in the Triassic conglomerate, and the cementing red earth which unites them, contains an adequate quantity of the same material, the rock possesses the character of a marble, as on the Potomac River. The Portland stone, or reddish-brown sandstone, so much used for building purposes in New York and other eastern cities, is from the Triassic formation.

Extensive mines for copper ore have been wrought in the Triassic, in the State of New Jersey, the ore occurring in every case adjacent to igneous traps, but not in contact with them. All these mining operations have failed, on account of the ore being diffused or disseminated through the mass of the formation, and not being found compacted in regular veins. In Europe, the upper part of the Triassic is called Keuper, or copper.

Trap-Dikes.—Numerous parallel ridges and dikes of Trap, some of them many miles in length, and with the elevation of mountains 400 feet high, and ridges of all sizes, traverse the Triassic. Indeed, nearly all the trap-dikes are confined to this formation. The material which composes these rough, rocky ridges, undoubtedly protruded in a state of fusion, slowly and gently through long narrow fissures, produced by the gaping asunder of the rocks, and not by enormous violent disruptions, like those of volcanoes, as the strata through which they passed are very little disturbed, and the dip of the strata is very little affected by them. These trap-dikes have burst through the red shale and sandstone, after they were deposited, overflowing, while in a melted and highly heated condition, the adjacent beds, and greatly altering their texture, color and mineral aspect. The finest of these trap-dikes is the Palisades, on the west side of the Hudson River, above Jersey City, and extending north of that place. (See note 5, in chapter on New York). The tunnels and deep railroad-cuts through it, in Jersey City, afford good opportunities to observe the appearance of the stone, the principal constituents of which are hornblende, feldspar, and titaniferous oxide of iron. The little mountain of iron ore at Cornwall, in Lebanon county, Pennsylvania, was thrown up by a trap-dike of the Triassic.

That the trap is not confined, however, to the Triassic rock surface, is beautifully shown by the very numerous trap-dikes which cut the Highlands of Orange county, N. Y., and of New Jersey; by the long, straight, narrow dike which issues from the South Mountain, opposite Carlisle, in Pennsylvania, and cuts across all the formations, from the Potsdam up to the Subcarboniferous, at the mouth of the Juniata, (see notes 9, 77 and 170, in chapter on Pennsylvania), and especially by the still longer trap-dike recently discovered by Prof. Frazer, in Lancaster county, Pa., which not only penetrates the Welsh hills of gneiss, but cuts across the west end of the Chester county (Pa.) Valley, near the famous nickel mine, and reaches the Susquehanna River near the roofing slates quarries at Peach Bottom.—Lesley.

The Triassic formation yields the rock-salt and brine of the greater part of Europe, especially in England, Ireland, France, and part of Germany.

17. Jurassic.—The upper portion of what is commonly called the Triassic, on the Atlantic border, may belong to the Jurassic, and is so described by Prof. P. R. Uhler, in the annexed Guide for Maryland; and by Prof. W. B. Rogers, as Juro-Triassic and Juro-Cretaceous, in Virginia. But there are beds which are undoubtedly Jurassic in several of the eastern ridges of the Rocky Mountains, and other districts of the far West. The rocks are, in general, a gray or whitish marly or arenaceous limestone, with occasional pure compact limestone beds, intercalated with laminated marls. The enormous *Dinosauria*, recently obtained by Marsh and Cope from Colorado, are from the Jurassic. It is much less important here than in England, where it is subdivided into the Liassic, Oolitic and Wealden. The name is derived from Mount Jura, in Switzerland.

18. Cretaceous.—The Cretaceous formation, along the Atlantic Coast and the lower Mississippi Valley, consists of a series of beds of strata, differing from each other; but they are all earthy in form, consisting of beds of sand and sandy-clay, except at a few points, where the strata have been cemented by oxide of iron into a kind of sandstone, or conglomerate. In Texas it contains extensive beds of gypsum. In New Jersey it produces the lower two beds of green-sand, called marl, which is extensively used in agriculture, the value of which is due to the potash and phosphates which it contains. Ninety per cent. of it is a green silicate of iron and potash, the rest being ordinary sand, and it contains no lime. But in Wyoming, Utah, and Colorado, the Cretaceous attains a thickness of 9,000 feet, and its rocks comprise beds of sand, marlite, clay, loosely aggregated shell-limestone, or rotten limestone, and compact limestone. At the middle of the Cretaceous, lie the beds of plastic-clay, outcropping across New Jersey, from Trenton to Amboy, and of great importance to the fire-brick and pottery factories, as described in the Report of Prof. Cook, of New Jersey, for 1876.

The name Cretaceous is from the Latin word for chalk, the chalk of England and Europe, being one of the rocks of this period; but in this country it contains no chalk, except in Western Kansas, 822 miles west of Kansas City, where a large bed exists. It is within one mile of Trego station on the Kansas Pacific Railroad, and is found over a tract 125 by 80 miles.

The Cretaceous formation, in the far West, passes upwards into a coal-bearing formation, several thousand feet thick, and covering on the upper Missouri River not less than 100,000 square miles in the United States, besides the portion of the belt extending into the British possessions. The area of other lignitic basins farther south, cannot be estimated, their width being unknown. Dr. Hayden

regards this coal-formation as transitional, or Lower Eocene 19. Tertiary, and in the within Guide for Colorado it is called the Lignitic Group, lying between the Cretaceous and Tertiary. Mr. Lesquereux is of the same opinion as to its Tertiary age, but nearly all other geologists regard it as Cretaceous.

In the annexed Guide for Wyoming and Utah, the formation is given at points where the coal is mined—Carbon, Separation, Black Buttes, Point of Rocks, Rock Springs, and Evanston. All the coal now mined in Wyoming is, according to the Guide, in the 18 d. Laramie Cretaceous, which corresponds with Hayden's Lignitic beds. Every division of the Cretaceous is said to be lignitic or coal-bearing, and may some day produce good coal. The Evanston beds are in the Laramie, but the Coalsville beds are probably in the 18 b. Colorado Cretaceous. The Rock Creek coal may be 18 c. Fox Hill.—A. Hague. There is no Carboniferous coal in the far west. The difference of opinion as to the age of the Lignitic or coal-bearing group, arises from the fact of its lying at the transition point from the Cretaceous to the Tertiary, where, as is not unusual, the fossils of both are mingled; and the controversy is as to precisely where the Cretaceous ends, and the Tertiary begins.

19-20. CENOZOIC.

19. Tertiary.—The Tertiary formation of the Atlantic coast is wholly of an earthy character, without solid rocks, consisting of sands and sandy blue clays, and above these yellow and brown ferruginous sand; also clays and sands imbedding extensive layers of uncemented fossil shells. But as we trace them south and southwest through the Southern cotton-growing states, it becomes more calcareous, consisting of lead-colored sandy clays, and whitish and bluish friable limestone in North and South Carolina and Eastern Georgia. West of that, the upper member consists of two limestone strata, the middle of sand and sandy marl, and the lower part of limestone and marl. H. D. Rogers suggests that on the Atlantic slope, opposite the Appalachian Mountains, the older rocks furnished only sandy and clayey sediments, and the Tertiary deposits composed of the ruins of the former, are of that character; while farther west a wide expanse of limestones fills the upper valley of the Mississippi, and hence the Tertiary deposits bordering the Gulf of Mexico, and extending up the Mississippi River, are of a greatly more calcareous or lime-bearing character. The cotton-growing lands of the Southern States are chiefly Tertiary. In the central part of the continent, the Tertiary beds are lake sediments, or fresh-water deposits; while on the west coast they are marine. The Tertiary, in the southern part of New Jersey, furnishes great quantities of bog iron-ore, but bog iron-ore is not peculiar to the Tertiary formation. The upper bed of the green-sand of New Jersey is Tertiary. In the far-west the Tertiary strata are in a greatly more indurated or rocky condition than those of the eastern coast. The 19 a. Eocene consists of beds of clay and sand, with round ferruginous concretions and numerous seams and local deposits of lignite, according to Mr. Lesquereux. Also gray and ash-colored sandstone, with more or less argillaceous layers. The 19 b. Miocene consists of white and light drab clays, with some beds of sandstone and local layers of limestone. The 19 c. Pliocene is composed of fine, loose sand, with some layers of limestone, and contains fossil bones of animals, which are scarcely distinguishable from living species.

20. Quaternary.—In no part of the United States are the phenomena of the drift displayed on a grander scale than in the Lake Superior region and on the northern borders of Wisconsin. These drift materials consist of vast accumulations of sand, pebbles and boulders, belonging invariably to rocks lying north or north-west of their present position, with beds of clay of great thickness, evidently brought from a great distance from the north by causes quite different from any now in operation, and which nearly all geologists now believe to have been glaciers. This material is spread over the whole breadth of the North American continent, down to 38° or 40° of latitude, with long tails projecting farther south along the valleys, and it is also spread in the same way over the northern part of Europe.

Minnesota and Dakota are very deeply buried in drift. At the south side of Lake Superior the drift is frequently 200 to 300 feet deep, and at the west end of that lake, from 300 to 600 feet thick, and it is 220 feet deep at Fargo, Minnesota. The whole of the lower peninsula of Michigan is covered from 200 to 300 feet deep. To the southward the drift diminishes, and it becomes more evenly spread over the country. It is a singular fact that in the Galena lead region, at the corner of Illinois, Iowa and Wisconsin, bounded by the Mississippi, Wisconsin and Rock Rivers, and in a considerable extent of territory north of it, no trace of transported drift material can be found. The driftless region is 12,000 square miles in Wisconsin alone, or one-fourth the area of the state. Prof. N. H. Winchell explains its removal by the action of glacial rivers; but Professors Chamberlin and Irving produce much evidence to show that this district never was covered with drift, the glacier terminating northeast of it in the moraine called the Kettle Range, so named from the great number of kettle-shaped depressions it contains on its surface. No other state has so complete a series of these deposits as Ohio, although not in so heavy a body as at places farther north, and it has been well studied and described by Dr. Newberry. He has classified the drift deposits as follows, in the ascending order: 1—The Erie clay, a blue or gray unstratified boulder clay, so conspicuous in the North-west, and in which the tunnels at Chicago are dug. 2—The forest-bed, consisting of a bed of soil, with timber, the remains of an ancient forest, found in Ohio, Indiana, etc., at various depths from the present surface. 3—Lacustrine deposits, stratified sands and clays in Northern Ohio; yellow clay, abounding with gravel, in Southern Ohio. The Loess or Bluff formation of the West, Dr. Newberry thinks is simply the silt brought down by the Missouri River, and deposited in a lake or great inland sea.

Nearly every recently uncovered ledge of rock in the drift-covered region has its surface marked with the characteristic striæ and furrows. These scratched, polished and grooved surfaces prove the former existence, according to Agassiz's theory, of an ice sheet, many thousand feet in thickness, moving across the continent over open level plains, as well as along enclosed valleys. When softer and harder rocks alternate, they are planed off to one outline or level, as if a rigid rasp had moved over the land levelling all before it. On the contrary, on any surface where water flows we find the softer materials have yielded first and been worn out, while hard rocks will be left standing out, and show greater resistance. Glacial surfaces are highly polished, and are marked with scratches, grooves and deeper furrows. Sometimes the smooth surfaces are like polished marble, showing that the grinding material was held steadily down in firm, permanent contact with the rocky surface against which it moved, as is the case with the glacier. There are many deep ancient channels filled by the drift.

The usual characteristic marks of glaciers extend, according to Agassiz, over the whole surface of the east half of the continent, from the Atlantic shores to the states west of the Mississippi, and from the Arctic Sea to the latitude of the Ohio, about the 40th degree of north latitude. The glacier marks tend from north to south, with occasional slight inclinations to the east or west, according to the minor irregularities of the surface. The ice of the great glacial period in America is supposed to have moved over the continent as one continuous sheet, over-riding nearly all the inequalities of the surface. The drift spread in one vast sheet over the whole land, consisting of an indiscriminate medley of clay, sand, gravels, pebbles, boulders of all dimensions, so uniformly mixed together that in all parts of the country it presents hardly any difference. The total absence of stratification is one important characteristic of glacial drift. There is no arrangement of the materials according to size or weight, whereas in water the lighter materials are carried farther than the heavier ones, and the heavier ones are at the bottom and the lighter on top. In glacial drift there are large angular fragments by which it may be distinguished from alluvium, and it retains the mud gathered during the journey, and spread through its mass, while the water-worn deposits are washed clean, and consist always of well-rounded pebbles, and there are no scratches on the exposed surfaces of the solid rocks.

There appeared in 1878 a map of New Jersey, on which the ice-covered area of that state is laid down, with a description of the terminal moraine, extending from below Belvidere, on the Delaware, first east and then south and southeast to South Amboy, across Staten Island and through the middle length of Long Island. Prof. Hitchcock has traced it thence eastwardly to Massachusetts Bay. Ice covered the highest peaks of the northern mountains of New Jersey, as it did all the mountain crests of Eastern Pennsylvania, to within ten or fifteen miles of Harrisburgh. The southern limit of the moraine has been fixed, by Mr. Carll, at Titusville, in Venango County, and by Prof. White, at Newcastle and Beaver Falls, in Beaver County. There blocks of granite from Canada lie perched on hill-tops of Coal Measures 1,300 feet above tide level.

Much of the configuration of the country has been attributed to the action of glaciers, but Professor J. P. Lesley has advanced the theory that most of the topographical features of the Atlantic half of the United States, including the erosion of Lakes Champlain and Ontario, and Georgian and Green Bays, the Blue-grass country of Kentucky, the central basin of Tennessee, the great valley of Eastern Tennessee, Virginia, Pennsylvania and New Jersey, the Taconic valleys of Western New England, and the rich valleys of the interior parts of the Appalachian Mountain belt, have been due, as he thinks, to the *underground* dissolution of the Lower Silurian limestone formations, and to the consequent breaking down of the Paleozoic roof above the caverns thus excavated: the process, however, beginning with the limestones of the carboniferous and sub-carboniferous age, being continued by the second subterranean erosion of the Upper and Lower Helderberg limestones, causing Lakes Erie, Huron and Michigan, the smaller New York lakes,* and the "Poor Valleys" of the Middle and Southern Atlantic States, and ending with the subterranean erosion of the Trenton and Calcareous formations, which, he says, is, in fact, seen to be still going on.

One of the most notable features of the Western States is the PRAIRIES, which are vast natural meadows, sometimes hundreds of miles in extent, bare of trees

*These and other features of Central New York, may have originated from the solution of large of rock-salt in the underlying Salina formation, and the consequent subsidence of the strata.

and covered with grass, growing on a deep, rich, comminuted soil of unsurpassed fertility, and with scarcely any exposures of the underlying rock.

The Bluff formation along the Missouri and Mississippi rivers is a very peculiar and interesting one, resting upon and later than the drift. It is of a slightly yellowish ash-color, very fine, not sandy, and yet not adhesive. It makes an excellent soil, is easily excavated by the spade alone, and yet it remains so unchanged by the atmosphere and frost, that wells dug in it require to be walled only to a point above the water-line, while the remainder stands so securely without support that the spade-marks remain upon it for many years. Road embankments and excavations upon the sides of roads stand like a wall. The peculiar outline of the bluffs along the Missouri river valley is very interesting. They are often naked, entirely destitute of trees, and tower up from the river bottom-land, sometimes more than two hundred feet in height, and so steep, in some places, that a man cannot climb them, yet they are not supported by a framework of rocks, as other bluffs are, and not a rock or pebble of any size exists in them, except a few calcareous concretions where lime-water percolates through them. It is a lacustrine deposit, a shallow lake having, after the time of the Glacial epoch, occupied the whole of the basin of the Mississippi before the great rivers had cut their valleys down to their present depths.—White. In Louisiana the Bluff deposit contains three distinct groups of strata, the Port Hudson below, the Loess next and the yellow loam above, over this is the alluvium, and below them all, the drift.—F. V. Hopkins.

Earthy material brought together by the ordinary action of water is said to be alluvial, and the soil or land so formed is called alluvium or alluvion. Diluvium implies the extraordinary action of water. When the drift material covers the surface, of course it forms the soil, but in driftless regions the soil is an admixture of clay, sand, lime, etc., derived from the disintegration of the rocks beneath, with decomposed animal and vegetable substances. Where neither glacial nor alluvial action has taken place—as in some parts of our Southern States—the rocks as described by Dr. T. S. Hunt, are converted into a deep and strong soil, having undergone a process of decay which has rendered them so soft, sometimes to a depth of twenty feet or more, that they may be readily cut by a spade, although retaining all the veins and layers which mark their original stratification. Without having been broken or ground up, even the hardest rocks have quietly mouldered into a soft, clayey mass, which, from its peculiar structure, has a natural drainage and possesses, moreover, great fertility.

The most important of geological formations is the last of all, the soil. On this thin, superficial, earthy covering of our planet, depends the growth of all vegetation, and on that depends all terrestrial animal life. But whether the material forming the soil remains unmoved in the same spot where it was once a solid rock, or is transported bodily by a glacier, or carried from the hills into the valleys by running water, and moved from place to place by larger streams and rivers, it was originally derived from the rock formations, therefore the agricultural as well as the mineral resources of the country depends on its geology.

This completes, in brief, the description of all that can be seen of the earth, classified in geological order, from the oldest of the rocks, up to the sands which are now daily washed to our feet, by the currents of the rivers and the waves of the sea.

REMARKS ON THE FOREGOING DESCRIPTIONS.

Paleontologists will be disappointed in this introduction, from which that is omitted which seems to them the most important, and gives the most interest and significance to the subject, namely: the life which they find in the formations, and which serves so important a purpose in their identification and classification. But another book would have been required for that purpose, and it would have been useless without a large number of expensive engravings.* Paleontology is the province of all the text-books on geology, to which this work is a supplement, not a substitute. Its only object is to teach local geology. The descriptions were an after-thought, and they should be regarded as an attempt—to present to the unlearned a first-lesson in geology, in the vernacular tongue, in the hope that it may help on the cause of popular science. They have swollen much beyond the original design, which was definitions, rather than descriptions; but they will serve to show that paleontology is not the whole of geology, and that the formations are more than a mere cabinet of fossils.

There are some things in the descriptions that are not accepted by all geologists. But the scope of the work did not permit any account of the conflicting opinions on disputed points, or discussions of the history of geological nomenclature and classification. Whether the Oriskany sandstone should be placed at the base of the Devonian, or at the top of the Silurian; whether Hudson River, Loraine, Nashville, or Cincinnati, is the best name for that formation; and whether Cambrian should include one, or all, or none of the Lower Silurian formations, and similar questions, seem of less importance to the ordinary reader, for whom the descriptions are intended, than to the professional geologist.

All kinds of geological tables are given, for, in accepting the valuable contributions of others on local geology, it was necessary to let them have their own way, in the chapters on their own States, in regard to the names and the arrangement of the formations. A common number, attached to them throughout the book, serves to identify the formations by whatever name they are called.

The valuable part of the book is the Geological Railway Guide, the design or plan of which is original with the author, as it is believed nothing of the kind has ever appeared, in any language. It is the work of many hands, and the hearty thanks of every lover of the science are due to all those who have contributed to its pages portions of the multitude of facts, forming this index to the geology of all important places in the United States and Canada. The reader will never know the amount of time, patience, labor, and care that it has cost.

* See "THE ANCIENT LIFE HISTORY OF THE EARTH," a comprehensive outline of the principles and leading facts of Paleontological Science. By H. A. Nicholson. Published by D. Appleton & Co., New York. 8vo., 407 pp. \$3.00. A very convenient and excellent manual of Paleontology only.

ARRANGEMENT OF THE GEOLOGICAL RAILWAY GUIDE AND DIRECTIONS FOR USING IT.

1. The railroads are arranged by states, and the states and territories are arranged in geographical order, with reference to the great lines of travel. But to find a railroad, the reader must depend on the index. Branches are placed after the main line, which is generally first given throughout without interruption.

2. When stations are omitted for the sake of brevity, which is seldom the case, the lists being uncommonly full, their geology will be understood to be the same as that given at the stations between which they occur. If the geology of two adjacent stations is different, it is evident enough that there is a transition from one to the other formation, between the stations, but the change is often so gradual that the transition point cannot be precisely given.

3. A few feet of difference in level sometimes carries the railway track to an upper or lower formation. Railroads, too, sometimes run across narrow, projecting tails, and scalloped points of a higher or lower formation, than that given in the Guide, but which it would occupy too much space to specify. Where too, the strata are disturbed and broken-up, all the formations cannot well be specified for want of room. In such cases the Guide serves only to show nearly where you are, the prevalent formation being given.

4. The hills, bluffs and higher ground in view, are often of a different formation from that given on the railroad, but not always higher in the series. Their elevation is often due to the hardness of the strata, the softer rocks forming the valleys, in which railways generally run.

5. Keep in mind the succession of the formations, as shown on the Guide, and whether you are going from older and lower to younger or higher strata, or *vice versa*. Notice the changes in the scenery with the changes in the formations.

6. When you come to a new formation, refer to the description of it, in the beginning of the book. But it is difficult to get a clear idea of the formations from even the best description. The reader must see them for himself, and these descriptions are intended to assist him in identifying them, and to impress their character and appearance upon his mind, or to recall them to his recollection after having seen them.

7. By a little close observation of the formations in traveling, you will find that most of them have peculiarities of their own, by which you can always know them, but which, like the features or appearances of persons, cannot be put into words, so that another who has not seen them could also recognize them. The form of the summits and slopes of the hills, and the general aspect of the country, but especially the rock-cuts on the railways, and other exposures of the formations, in quarries, and in the banks and beds of streams, should be closely observed; and if these are not visible, notice the stone used in buildings, and for the enclosures of fields, the character of the soil, and the fragments of stone mixed through its mass, which betray the nature of the solid rock formation beneath; observe also whether the rocks lie horizontally or in an inclined position.

Prof. J. D. Dana's Table of the Geological Formations (1878).

Systems or Ages.	GROUPS OR PERIODS.	FORMATIONS OR EPOCHS.
Age of Man.	20. QUATERNARY.	20. Quaternary.
Age of Mammals.	19. TERTIARY.	19 c. Pliocene. 19 b. Miocene. 19 a. Eocene.
Reptilian Age.	18. CRETACEOUS.	18 c. Upper Cretaceous. 18 b. Middle " 18 a. Lower "
	17. JURASSIC.	17. Jurassic.
	16. TRIASSIC.	16. Triassic.
Carboniferous.	15. PERMIAN.	15. Permian.
	14. CARBONIFEROUS.	14 c. Upper Coal Measures. 14 b. Lower " " 14 a. Millstone Grit.
	13. SUBCARBONIFEROUS.	13 b. Upper Subcarboniferous. 13 a. Lower "
Devonian, or Age of Fishes.	12. CATSKILL.	12. Catskill.
	11. CHEMUNG.	11 b. Chemung. 11 a. Portage.
	10. HAMILTON.	10 c. Genesee. 10 b. Hamilton. 10 a. Marcellus.
	9. CORNIFEROUS.	9 c. Corniferous. 9 b. Schoharie. 9 a. Cauda Galli.
	8. ORISKANY.	8. Oriskany.
Silurian, or Age of Invertebrates.	7. LOWER HELDERBERG.	7. Lower Helderberg.
	6. SALINA.	6. Salina.
	5. NIAGARA.	5 c. Niagara. 5 b. Clinton. 5 a. Medina.
	4. TRENTON.	4 c. Cincinnati. 4 b. Utica. 4 a. Trenton.
	3. CANADIAN.	3 c. Chazy. 3 b. Quebec. 3 a. Calciferous.
	2. PRIMORDIAL OR CAMBRIAN.	2 b. Potsdam. 2 a. Acadian.
	1. ARCHÆAN.	1 b. Huronian. 1 a. Laurentian.

The numbers and letters of this table are attached to the same formations or their equivalents throughout the book.

Table of the Geological Formations.

ARRANGED FOR THIS WORK BY PROF. T. STERRY HUNT, LL. D., F. R. S.

AGES.	GROUPS.	AMERICAN FORMATIONS.
Cenozoic.	20. QUATERNARY.	20. Recent.
	19. TERTIARY.	19 c. Pliocene. 19 b. Miocene. 19 a. Eocene.
Meso- zoic.	18. CRETACEOUS. 17. JURASSIC. 16. TRIASSIC.	18. Cretaceous. 17. New Red Sandstone. 16. New Red Sandstone.
Palaeozoic.	13-15. CARBONIFEROUS.	15. Permo-Carboniferous. 14. Coal Measures. 13 b. Mississippi, (Carb. limestone.) 13 a. Waverley or Bonaventure.
	8-12. ERIAN OR DEVONIAN.	12. Catskill. 11. Chemung and Portage. 10. Hamilton, (including Genesee and Marcellus.) 9. Corniferous or Upper Heldb'rg. 8. Oriskany.
	5-7. SILURIAN.	7. Lower Helderberg. 6. Onondaga or Salina. 5 c. Niagara, including Guelph. 5 b. Clinton. 5 a. Medina. 5 " Oneida.
	4. UPPER CAMBRIAN OR SILURO-CAMBRIAN.	4 c. Loraine, 4 b. Utica, 4 a. Trenton,
	3. MIDDLE CAMBRIAN.	3 c. Chazy. 3 b. Levis, (Tremadoc and Arenig.) 3 a. Calciferous.
	2. LOWER CAMBRIAN.	2 d. Potsdam. 2 c. Sillery. 2 b. Acadian, (Menevian.) 2 a. Lower Taconic.
	1. PRIMARY OR CRYSTALLINE.	1 d. Montalban. 1 c. Norian or Labrador.* 1 b. Huronian. 1 a. Laurentian.
Eozoic.		

* There are many reasons for believing the Norian to be older than the Huronian.—T. S. R.

The Dominion of Canada.¹

List of the Geological Formations of Canada:

16. Triassic.			
14. Coal Measures.			
13 b. Mississippi, Carb. l. s.	} Carb.		
13 a. Bonaventure, or Waverley.			
12. Catskill, (Old Red Sandstone.)			
11 b. Chemung and Portage.		} Devonian.	
10 b. Hamilton, inc. Mar. & Gen.			
9 c. Corniferous, or Up. Held.			
8. Oriskany.			
7. Lower Helderberg.			
6. Salina, or Onondaga.	} Silurian.		
5 d. Quelfh.			
5 c. Niagara.			
5 b. Clinton.			
5 a. Medina and Oneida.			
4 c. Loraine.		} 4. Upper Cambrian	
4 b. Utica.			or Siluro-Cambrian.
4 a. Trenton.			
3 c. Chazy.		} 3. Middle Cambrian.	
3 b. Levis.			
3 a. Calciferous.			
2 d. Potsdam.			
2 c. Sillery.		} 2. Lower Cambrian.	
2 b. Acadian.			
2 a. Lower Taconic.			
1 d. Montalban.		} 1. Eozoic or Crystalline.	
1 c. Norian or Labrador. ²			
1 b. Huronian.			
1 a. Laurentian.			

Ms. | 1 The Grand Trunk Railway.

0 PORTLAND, Me.	1 d. Montalban.
11 Yarmouth.	"
27 Danville Junc.	"
36 Mechanics' Fls.	"
47 South Paris.	"
70 Bethel.	"
91 Gorham, N. H.	"
123 Groveton Jun.	1 b. Huronian.
134 N. Stratford.	"
149 Island Pond.	1 d. Montalban.
166 Norton Mills.	"
175 Coaticook.	2. Lower Cambrian.
186 Westerville.	"
193 Lennoxville.	2. Lower Cambrian.
196 Sherbrooke.	1 b. Huronian.
217 - - - -	"
221 RICHMOND.	"
228 Lisgar.	"
235 Durham.	2. Lower Cambrian.
243 Acton.	"
255 Britannia Mills	"
262 St. Hyacinthe.	4 c. Loraine.
275 St. Hilaire.	"
282 St. Bruno.	"
292 St. Lambert.	4 b. Utica, 5 m.
297 MONTREAL.	4 a. Trenton.

Riviere du Loup Branch.

0 Point Levis.	3. Middle Cambrian.
8 Chaudière.	2. Lower Cambrian.
11 St. J. Chrisost.	"
28 St. Michael.	"
46 St. Thomas.	"
60 L'Islet.	"
76 St. Roch.	"

Ms. | Riviere du Loup Branch—Con.

95 St. Denis.	2. Lower Cambrian.
105 Ste. Helène.	"
125 Riv. du Loup.	"
130 St. Arsène.	"
138 Isle Verte.	"
144 Trois Pistoles.	"

Quebec Branch.

0 Point Levis, opposite Queb.	3. Middle Cambrian.
55 Stanford.	1 b. Huronian.
64 Arthabaska.	"
96 RICHMOND.	"

Arthabaska Branch.

0 ARTHABASKA.	1 b. Huronian.
48 Aston.	"
25 St. Celestin.	4 c. Loraine, 4 miles.
31 St. Gregoire.	5 a. Medina, 6 miles.
35 THREE RIVERS.	4 c. Loraine, 3 miles.

Montreal to Toronto and Detroit.

0 Montreal.	4 a. Trenton, 14 miles.
8 Lachine Jun.	"
14 Point Claire.	"
21 Ste. Anne.	3 a. Calciferous, 7 miles
24 Vaudreuil.	2 b. Potsdam, 10 miles.
31 St. Dominique.	"
37 Coteau Land'g.	3 a. Calciferous, 3 miles
48 Bainsville.	3 c. Chazy, 33 miles.
54 Lancaster.	"
59 Summertown.	"
67 Cornwall.	3 a. Calciferous, 5 miles
72 Mille Roches.	4 a. Trenton, 2 miles.
77 Dickinson.	3 c. Chazy, 30 miles.
81 Farran's Point.	"
92 Morrisburg.	"

1. Corrected and the nomenclature arranged by Prof. T. Sterry Hunt, LL. D., F. R. S.

2. The Norian or Labrador series (Upper Laurentian of Logan) is found, like the Huronian, to rest unconformably upon the Laurentian, but its true relation to the Huronian being yet undetermined, the position at present assigned to it in the Eozoic succession is only provisional.—T. S. H.

Grand Trunk Railway.			Grand Trunk Railway.		
Ms. (Montreal to Toronto and Detroit—Con.)			Ms. Montreal to Toronto and Detroit—Con.		
99 Iroquois.	3 c. Chazy.		454 Ailsa Craig.	10 b. Hamilton, 23 m.	
104 Edwardsburg.	3 a. Calciferous.		461 Park Hill.	"	
112 Prescott Jun.	"		470 Widder.	"	
112 Prescott Jun.	3 a. Calciferous-45 m.		479 Forrest.	11 b. Chemung, 91 m.	
164 Ottawa.	3 c. Chazy, 7 miles.		496 Blackwell.	"	
116 Gladstone.	3 a. Calciferous.		501 SARNIA.	"	
120 Maitland.	"		502 P. Huron, Mich.	"	
125 BROCKVILLE.	"		512 Ch. & L. H. Jun.	"	
129 Lyn.	2 b. Potsdam.		557 Milw. June.	"	
138 Mallorytown.	"		561 Detroit June.	"	
147 Landsdowne.	1 a. Laurentian, 34 m.		564 DETROIT.	10 b. Hamilton, 3 miles.	
155 Gananoque.	"		Buffalo to Goderich and Detroit.		
162 Ballantyne's.	"		0 BUFFALO.	10. Hamilton, 2 miles.	
169 Rideau.	"		2 Fort Erie.	9. Corniferous, 30 m.	
172 KINGSTON.	"		19 Port Colborne.	"	
180 Collins' Bay.	4 a. Trenton, 114 miles.		32 Feeder.	6. Salina, 60 miles.	
194 Fredericksb'rg	"		38 Dunnville.	"	
198 Napanee.	"		59 Caledonia.	"	
213 Shannonville.	"		68 Onondaga.	"	
223 BELLEVILLE.	"		76 BRANTFORD.	"	
232 Trenton.	"		84 Paris.	"	
241 Brighton.	"		82 Drumbo.	"	
249 Colborne.	"		97 Bright.	9. Corniferous, 68 m.	
256 Grafton.	"		115 STRATFORD.	"	
264 COBOURG.	"		128 Mitchell.	"	
270 PORT HOPE.	"		139 Seaforth.	"	
279 Newtonville.	"		148 Clinton.	"	
286 Pt. Newcastle.	"		160 GODERICH.	"	
290 Bowmanville.	4 b. Utica, 24 miles.		Montreal to St. John's and Rouse's Point.		
294 Saxony.	"		0 MONTREAL.	4 a. Trenton, 2 miles.	
299 Oshawa.	"		2 St. Lambert.	4 b. Utica, 19 miles.	
303 Whitby.	"		17 Laprairie Jun.	"	
310 Dunn's Creek.	"		21 Lacadie.	"	
316 Port Union.	4 c. Loraine, 44 miles.		27 St. John's.	4 a. Trenton, 29 miles.	
324 Scarboro Jun.	"		40 Stottsville.	"	
333 TORONTO.	"		45 Lacolle.	"	
341 Weston.	"		50 ROUSE'S POINT.	"	
354 Brampton.	5 a. Medina, 11 miles.		Montreal to Lachine and Province Line.		
362 GEORGETOWN.	"		0 MONTREAL.	4 a. Trenton, 10 miles.	
365 Limehouse.	5 d. Guelph, 26 miles.		8 Lachine.	"	
368 Acton West.	"		10 Caughnawaga.	4 a. Trenton.	
374 Rockwood.	"		15 St. Isidore.	3 c. Chazy, 18 miles.	
381 GUELPH.	"		21 St. Remi.	"	
386 Balmoral.	"		28 Hughes.	3 a. Calciferous, 12 m.	
391 Breslau.	"		36 Hemmingford.	"	
396 Berlin.	6. Onondaga, 14 miles.		40 PROVINCE LINE	"	
403 Doon.	5 a. Guelph.		2 Canada Southern Railway.		
408 Galt.	"		0 BUFFALO.	9. Corniferous, 2 miles.	
402 Petersburg.	6. Onondaga.		6 Victoria.	6. Onondaga. 58 miles.	
405 Baden.	7 & 8. Cornif. 16 m. and		8 Niagara June.	"	
421 STRATFORD.	" [Oriskany		23 Welland.	"	
421 STRATFORD.	" 33 m.		32 Perry.	"	
432 St. Mary's.	"		47 CANFIELD.	"	
444 Thorndale.	"		54 Dean's.	"	
454 LONDON.	"		64 Hagersville.	9. Corniferous, 64 miles.	
421 STRATFORD.	" 26 m.		72 Villa Nova.	"	
432 St. Mary's.	"				
447 Lucan.	"				

Ms. Canada Southern Railway—Con.			Ms. Great Western Railway—Con.		
83	Windham.	9. Corniferous.	168	Thamesville.	10 b. Hamilton, 25 m.
99	Tilsonburg.	"	183	Chatham.	"
111	Springfield.	"	198	Prairie.	9. Corniferous, 86 m.
124	St. THOMAS.	10. Hamilton, 74 miles.	207	St. Clair.	"
128	St. CLAIRE JN.	"	221	Tecumseh.	"
137	Iona.	"	229	WINDSOR.	"
150	Bismark.	"	230	DETROIT.	10 b. Hamilton, 1 m.
162	Highgate.	"	Great Western Railway Air Line.		
187	Buxton.	"	00	Buffalo.	9. Corniferous, 75 m.
198	Tilbury.	"	16	Welland.	"
204	Comber.	9. Corniferous, 48 miles.	72	Simcoe.	"
213	Woodslee.	"	81	Delhi.	10 b. Hamilton, 68 m.
227	Colchester.	"	99	Corinth.	"
235	AMHERSTBURG.	"	112	New Sarnia.	"
236	Grosse Isle.	"	117	St. Thomas.	"
239	Trenton.	"	136	Baird's.	"
256	DETROIT.	10. Hamilton, 10 miles.	180	Lawrence.	"
0	Buffalo.	9. Corniferous.	145	GLENCOE.	11 b. Chemung, 2 m.
8	Niagara Junc.	6. Onondaga.	224	Windsor.	"
19	Black Creek.	5 d. Guelph.	225	Detroit.	"
25	Chippewa.	5 c. Niagara.	4 Toronto, Grey and Bruce Railway.		
28	Clifton House.	"	0	TORONTO.	4 c. Loraine, 83 miles.
29	Susp. Bridge.	"	9	Western Junc.	"
35	Queenston.	5 a. Medina.	22	Kleinburg.	"
42	Niagara.	"	27	Bolton.	"
3 Great Western Railway.			33	Mono Road.	5 a. Medina, 5 m.
Susp. BRIDGE.			41	Charleston.	5 c. Niagara, 11 m.
0	Clifton.	5 c. Niagara, 9 miles.	49	Orangeville.	"
9	Thorold.	"	64	Shelburne.	5 d. Guelph, 38 m.
11	St. Catharines.	5 a. Medina, 34 miles.	81	Proton.	"
27	Grimsby.	"	87	Flesherton.	5 c. Niagara, 6 m.
43	HAMILTON.	"	93	Markdale.	5 d. Guelph, 16 m.
43	HAMILTON.	5 a. Medina, 32 miles.	98	Berkeley.	"
45	Toronto Junc.	"	107	Arnot.	"
56	Bronte.	"	109	Chatsworth.	5 c. Niagara, 13 m.
69	Port Credit.	"	114	Rochford.	"
75	Mimico.	4 c. Loraine, 7 miles.	122	OWEN SOUND.	"
82	TORONTO.	"	5 Northern Railway of Canada.		
43	HAMILTON.	5 b. Clinton.	0	TORONTO.	4 c. Loraine, 24 miles.
	Dundas.*	{ 5 c. Niagara.	14	Thornhill.	"
		{ 5 b. Clinton.	18	Richmond Hill	"
55	Copetown.	5 d. Guelph.	22	King.	"
59	Lynden.	"	30	Aurora.	4 b. Utica, 14 m.
62	HARRISBURG.	"	34	Newmarket.	"
65	St. George.	"	38	Holland.	"
67	Dumfries.	6. Onondaga.	49	Gilford.	5 d. Guelph, 34 m.
72	PARIS.	" Gravel ridge.	52	Lefroy.	"
79	Princeton.	"	57	Bramley.	"
84	Governor's.	9. Corniferous.	63	Allendale.	"
80	Woodstock.	"	74	Angus.	4 b. Utica.
110	Dorchester.	"	86	Stayner.	"
119	LONDON.	"	94	COLLINGWOOD.	"
129	Komoka.	10 b. Hamilton, 26 m.	105	Meaford.	4 c. Loraine, 16 miles.
140	Longwood.	"			
145	Appin.	11 b. Chemung, 23 m.			
156	Newbury.	"			

*At Dundas, close to Station, on N. side, a fine section of Niagara and Clinton.

6 Intercolonial Railway.			Intercolonial Railway.— <i>Con.</i>		
Eastern Division.			Continuation of Northern Division.		
0	Halifax.	2. Lower Cambrian.	477	Ste. Flavie.	2. Lower Cambrian.
8	Bedford.	" "	515	St. Fabien.	" "
13	Windsor Junc.	" "	534	Trois Pistoles.	" "
28	Enfield.	" "	552	Isle Verte.	" "
30	Elmsdale.	" "	561	Rivière du Loup.	" "
35	Milford.	13 a. Bonaventure.	Pictou Branch.		
39	Shubenacadie.	" "	61	Truro.	16. Triassic.
44	Stewiacke.	" "	70	Union.	13 a. Bonaventure.
53	Brookfield.	" "	74	Riverdale.	" "
61	Truro.	16. Triassic.	82	West River.	5-7. Silurian.
Central Division.			89	Glengarry.	13 a. Bonaventure.
61	Truro.	16. Triassic.	96	Hopewell.	14. Coal Measures.
		13 a. Bonaventure.	104	New Glasgow.	" "
		14. Coal Measures.	112	Pictou Land'g.	" "
		13 a. Bonaventure.	113	Pictou.	" "
78	Londonderry.	5-7. Upper Silurian.	Shediac Branch.		
		Granite.	179	Painsec Junc.	14. Coal Measures.
90	Wentworth.	14. Coal Measures.	184	Dorchester Rd.	" "
130	Maccan.	13 a. Bonaventure.	188	Shediac.	" "
138	Amherst.	" "	190	Pt. du Chene.	" "
144	Aulac.	14. Coal Measures.	7 Windsor and Annapolis Railway.		
147	Sackville.	" "	0	Halifax.	2. Lower Cambrian.
159	Dorchester.	" "	13	Windsor Junc.	" "
167	Memramcook.	13 a. Bonaventure.	30	- - - -	(Outcrop of Granite.)
179	Painsec Junc.	14. Coal Measures.	39	Newport.	13 a. Bonaventure.
Western Division.			45	Windsor.	" "
179	Painsec Junc.	14. Coal Measures.	47	Falmonth.	" "
185	Humphrey's.	" "	52	Hantsport.	" "
189	Moncton.	" "	63	Wolfville.	16. Triassic.
197	Boundary Crk.	13 a. Bonaventure.	65	Port William.	" "
200	Salaberry.	" "	70	Kentville.	" "
210	Peticodiac.	" "	82	Berwick.	" "
216	Anagance.	" "	87	Aylesford.	" "
225	Penobscuis.	" "	98	Wilmot.	" "
232	Sussex.	" "	101	Middleton.	" "
237	Apohaqui.	" "	107	Lawrenceton.	" "
243	Norton.	" "	115	Bridgetown.	" "
250	Passekeag.	" "	121	Round Hill.	" "
254	Hampton.	" "	129	Annapolis.	9-11. Devonian.
259	Nauwigewauk.	" "	8 European and N. American R. R.		
267	Rothsay.	1 a. Laurentian.	0	St. John's.	1 a. Laurentian.
279	St. John.	" (2 b. Acadian.)	4	Fairville.	1 b. Huronian.
Northern Division.			16	Westfield.	" Granite.
187	Moncton.	14. Coal Measures.	26	Welsford.	" "
224	Welford.	" "	36	Enniskillen.	14. Coal Measures.
310	Bathurst.	2 Lower Cambrian.	46	Frederickton J	" "
329	Belledune.	13 a. Bonaventure.	67	Harvey.	" "
347	New Mills.	2. Lower Cambrian.	86	McAdam Jun.	1 d. Montal'n. (Granite.)
364	Dalhousie.	" "	91	St. Croix Jun.	" "
372	Campbellton.	5-7. Silurian.	118	Danforth.	1 b. Huronian.
395	Mill Stream.	" "	160	Lincoln.	" "
433	Amque.	9-11. Devonian.	183	Oldtown.	" "
448	Sayabec.	" "	206	Bangor.	" "
448	Sayabec.	2. Lower Cambrian.			

Maine. New Hampshire, Vermont, Massachusetts, Rhode Island and Connecticut.¹

Table of the Geological Formations of the New England States.

Cenozoic.		Eozoic. ²	
20. Quaternary.	20 b. Champlain Clays.	1 D. Huronian.	1 p. Merrimack qu. & sch.
"	20 a. Glacial Drift.	"	1 o. Hydro Mica (Talcose) Schists and Grits.
19. Tertiary.	19 c. Pliocene.	"	1 n. Quartzite, Indurated Slate, &c.
"	19 b. Miocene.	"	1 m. Felsite Porphyries.
"	19 a. Eocene.	"	1 l. Hornblende Schists.
Mesozoic.		"	1 k. Lisbon, Lyman & Swiftwater Series of N. H.
16. Triassic.	16. Triassic.	1 C. Labrador.	1 j. Franconia Breccia.
Paleozoic.		1 B. Montalban.	1 i. Andalusite Gneiss.
14. Carbonifer's.	14 b. Coal Measures.	"	1 h. Concord & Hallowell Granites.
"	14 a. Conglomerate.	"	1 g. Lake Winnipiseogee Gneiss.
8-10. Devonian.	10. s. s. pro'bly Hamilton.	"	1 f. Green Mount. Gneiss.
"	9. Upper Helderb'g l.s.	1 A. Laurentian.	1 e. Bethlehem "
"	8. Oriskany Group.	"	1 d. Porphyritic "
5-7. Silurian.	7. Lower Helderberg.	"	1 c. Adirondac "
"	5. Port Daniel (Niag'a)	"	1 b. K 2, K 3 of Percival.
3-4. Cambro-Silurian.	4 d. Magnesian Slate (Emmons), possibly Cambrian.	"	1 a. E. Mass. Gneiss, &c.
"	4 c. Loraine Shales.	Eruptive Rocks. ²	
"	4 b. Utica Slate.	K h. Mesozoic Dolerites.	
"	4 a. Trenton l. s.	J j. Labradorite Diorites.	
"	3 c. Chazy l. s. } Stock-	I i. Dolerites.	
"	3 b. Levis l. s. } bridge.	H h. Diorites.	
"	3 a. Calciferous s. s.	G g. Porphyry of White Mountains.	
"	2 j. Potsdam ss. sl. & qu.	F f. Granite, cutting Cambrian Slates.	
2. Cambrian. ³	2 i. Clay sl. (Georgian Group.)	E e. Chocorua Sienite and Granite.	
"	2 h. St. Johns or Brainerd Slate.	D d. Exeter (Quincy) Sienite.	
"	2 g. Taconic Slate.	C c. Albany Granite.	
"	2 f. Roxbury Conglom'e.	B b. Conway Granite.	
"	2 e. Calciferous Mica Schists.	A a. Trachyte, &c., of White Mountains.	
"	2 d. Staurolite Slate and Schists.		
"	2 c. Quartzite.		
"	2 b. Andalusite Schists.		
"	2 a. Rockingham Mica Schists.		

1. Prepared by Prof. C. H. Hitchcock, State Geologist of New Hampshire.

2. The Eruptive Rocks and the subdivisions of 1 and 2 are not necessarily consecutive. 2 c., 2 d. and 2 e. may yet prove to be Silurian.

Maine.

[illegible]

New Hampshire.⁸

Grand Trunk Railway.			Boston, Concord & Montreal Railroad.		
Ms.			Ms.		
0	Portland, Me.	1 c. Huronian.	0	Concord.	1 h. Concord Granite.
5	Falmouth.	"	10	Canterbury.	2 a. Rockingham Schist.
11	Yarmouth.	1 B. Montalban.	18	Tilton.	1 g. Lake Gneiss.
18	Pownal.	"	27	Laconia.	1 B. Montalban.
27	Danville Junc'n	"	33	Weirs.	1 d. Porphyritic Gneiss.
36	Mechanic Falls.	"	48	Ashland.	"
41	Oxford.	"	51	Plymouth.	1 B. Montalban.
47	South Paris.	"	59	Rumney.	"
55	West Paris.	"	67	Wentworth.	1 g. Lake Gneiss.
65	Locke's Mills.	"	71	Warren.	"
70	Bethel.	"	84	Haverhill.	1 c. Huronian.
80	Gilead.	"	93	Wells River.	" & 1 k. Lyman.
86	Shelburne.	"	103	Lisbon.	" & 1 k. Lisbon.
91	Gorham.	"		North Lisbon.	7. Helderberg.
98	Berlin Falls	1 g. Lake Group.	113	Littleton.	2 c. Coos & 7. Helderbg.
103	Milan.	"	120	Wing Road.	1 d. Porphyritic Gneiss.
122	Groveton.	1 c. Huronian.	124	Bethlehem.	1 e. Bethlehem Gneiss.
134	North Stratford	"	129	Twin Mountain.	" (Local Glacier.)
142	Wenlock.	Granite.	134	Fabyan's.	1 B. Montalban.
149	Island Pond.	"	120	Wing Road.	1 d. Porphyritic Gneiss.
166	Norton Mills.	"	128	Dalton.	1 c. Huronian.
175	Coaticooke.	2 e. Calcife's Mica Schist	135	Lancaster.	"
		(Continued in Canada.)	145	Groveton Junc.	"
Portland and Ogdensburg Railroad.			Concord Railroad of New Hampshire.		
0	Portland, Me.	1 c. Huronian.	0	Concord.	1 h. Concord Granite.
5	Westbrook.	1 B. Montalban.	5	Suncook.	1 B. Montalban.
11	South Windham	"	9	Hooksett.	"
17	Sebago Lake.	"	13	Martin's.	1 g. Lake Gneiss.
24	Steep Falls.	"	18	Manchester.	"
32	Baldwin.	"	26	Reed's.	"
43	Brownfield.	"	29	Thornton's.	"
49	Fryeburg.	"	35	Nashua.	1 p. Merrimack Group.
60	North Conway.	B b. Conway Granite.	Suncook Valley Branch.		
66	Glen Station.	C c. Albany Granite.	Hooksett.	1 B. Montalban.	
72	Upper Bartlett.	B b. Conway Granite.	Pittsfield.	2 a. Rockingham Schist.	
78	Bemis.	1 B. Montalban.	Concord and Portsmouth Railroad.		
87	Crawford.	"	0	Manchester.	1 g. Lake Gneiss.
91	Fabyan's.	"	8	Auburn.	"
95	Twin Mountain.	1 e. Bethlehem Gneiss.	18	Raymond.	1 c. Huronian.
101	Bethlehem.	"	24	Epping.	1 p. Merrimack Group.
105	Wing Road.	1 d. Porphyritic Gneiss.	31	New Market.	D d. Exeter Sienite.
114	Lunenburg.	1 k. Lyman Group.	41	Portsmouth.	1 p. Merrimack Group.
Northern New Hampshire Railroad.			Manchester and Lawrence Railroad.		
0	Concord.	1 h. Concord Granite.	0	Manchester.	1 g. Lake Gneiss.
7	Fisherville.	1 B. Montalban.	8	Wilson's.	1 p. Merrimack Group.
14	Nor. Boscowen.	"	14	Windham.	"
17	Franklin.	"	22	Messer's.	"
25	East Andover.	"	26	Lawrence.	"
31	Potter Place.	1 d. Porphyritic Gneiss.	Manchester and North Weare Railroad.		
44	Grafton.	"	0	Manchester.	1 g. Lake Gneiss.
52	Canaan.	1 l. Hornblende Schist.	11	Oil Mills.	"
59	Enfield.	1 e. Bethlehem Gneiss.	19	North Weare.	"
65	Lebanon.	"			
69	W.R. Junction.	1 l. Hornblende Schist.			

Cheshire Railroad.		Concord and Claremont Railroad.	
Ms.		Ms.	
0 Bellows Falls.	1 B. Montalban.	0 Concord.	
4 Walpole.	2 c. & d. Coos sch. & qu.	8 Mast Yard.	Ferruginous Schists.
10 Westmoreland.	1 l. Hornblende Schists.	12 Contoocook.	1 h. Concord Granite.
22 Keene.	1 e. Bethlehem Group.	18 Warner.	1 g. Lake Gneiss.
32 Troy.	4 B. Montalban.	23 Roby's Corners.	1 d. Porphyritic Gneiss.
37 Fitzwilliam.	1 a. Concord Granite.	27 Bradford.	"
43 State Line.	1 B. Montalban.	34 Newbury.	"
46 Winchester.	"	43 Newport.	4 g. Lake Gneiss.
54 S. Ashburnham.	"	48 Kellysville.	"
64 Fitchburg.	"	54 Claremont.	2 c. Calcifer's Mica Sch.
Ashuelot Railroad.		12 Contoocook.	1 h. Concord Granite.
0 Keene.	1 e. Bethlehem Group.	20 Henniker.	1 d. Porphyritic Gneiss.
8 Westport.	"	27 Hillsboro.	1 g. Lake Gneiss.
15 Ashuelot.	1 d. Porphyritic Gneiss.	Railroads not found under New Hampshire heading will be found in Massachusetts.	
24 South Vernon.	2 c. Coos Quartz.		

3. The New Hampshire formations are believed to possess thickness as follows: Helderberg, 500 feet; Calciferous Mica Schists, 4,600 feet; Coos Group, 7,300 feet; Cambrian Slates of Connecticut Valley, 3,000 feet; Kearsarge Group, 1,300 feet; Rockingham Mica Schists, 6,000 feet; Merrimack Group, 4,900 feet; Huronian, 12,000 feet; Montalban, 10,000 feet; Lake Winnepisseoga Gneiss, 18,000 feet; Bethlehem Gneiss, 11,300 feet; Porphyritic Gneiss, 5,000 feet.

Vermont.

Central Vermont Railroad.		Central Vermont Railroad.	
Southern Division.		Central Division—Continued.	
Ms.		Ms.	
127 Brattleboro.	2. Cambrian.	239 Northfield.	1 c. Huro'an Soapstone.
130 Putney.	2 d. Coos Schist.	249 Montpelier.	" and Clay Slate.
141 Westminster.	2. Cambrian.	258 Waterbury.	"
145 Bellows Falls.	1 B. Montalban.	266 Bolton. ⁵	1 f. Green Mt. Gneiss.
153 Charleston.	2 c. & d. Coos Group.	272 Richmond.	1 c. Huronian.
163 Claremont.	2 c. Calcifer's Mica Sch.	281 Essex Junction.	Clay Slate.
171 Windsor. ⁴	"	286 Winooski.	3 b. Levis Limestone.
179 North Hartland.	2. Camb. & 1 c. Huro'n.	289 Burlington.	2 j. Potsdam Sandstone.
185 White River Jn.	1 l. Hornbl. Schist.	292 Milton.	3 b. Levis Limestone.
		306 St. Albans.	2 j. Potsdam Slate.
Central Division.		Rutland Division.	
171 Hartford.	2. Cambrian.	0 Bellows Falls.	1 B. Montalban.
198 Sharon.	2 c. Calcifer's Mica Sch.	5 Rockingham.	2 e. Calcifer's Mica Sch.
205 Royston.	"	10 Chester.	1 g. Lake Gneiss.
216 Bethel.	1 c. Huro'an Soapstone.	22 Cavendish.	"
217 Randolph.	"	27 Ludlow.	1 c. Huronian.
223 Braintree.	"	34 Summit.	1 f. Green Mt. Gneiss.
232 Roxbury.	"Verde Antique.	39 E. Wallingford.	"

4. An interesting area has been traced from Lyme, N. H., to Windsor, Vt., about 30 miles long. Portions of it have been removed by the wearing action of the Connecticut. It appears to have been deposited by a powerful current derived from the melting of the glacial sheet prior to the accumulation of terraces.

5. The centre of the anticlinal axis of the Green Mountains. At least eight of the general sections of the Vermont survey show this feature of structure, proving this formation to be older than the Huronian adjacent upon both sides. This structure was denied by Logan for the continuation of the Vermont rocks in Canada in his generalizations, but the descriptions of the rocks confirm the views of the Vermont geologist.

Central Vermont Railroad.			Ms. Portland and Ogdensburg Railroad.		
Rutland Division—Continued.					
46 East Clarendon.	3 b. Levis Limestone.		0 Lunenburg.	1 k Lyman Gp. & 1 c Hur	
52 Rutland.	2 e. Calciferous Sand- rock, (Stockbridge.)		7 Miles Pond.	1 B. Montalban.	
59 Sutherland Falls	3 c. Chazy Marble.		13 West Concord.	2 c. and d. Coos Group.	
69 Brandon.	19 a. Eocene Tertiary.		21 St. Johnsbury.	2 e. Calcifer's Mica Schs.	
74 Leicester Junc.	3 c. Chazy Marble.		33 Danville.	"	
79 Salisbury.	3 b. Levis Limestone.		41 Walden.	"	
85 Middlebury.	"		49 Greensboro.	"	
89 Brooksville.	3 c. Chazy Limestone.		57 Hardwick.	"	
93 New Haven.	4 a. Trenton Limestone.		62 Wolcott.	1 c. Huronian.	
99 Vergennes.	3 c. Chazy Limestone.		70 Morrisville.	"	
109 Nor. Ferrisburg.	"		73 Hyde Park.	"	
113 Shelburne.	2 j. Potsdam Sandstone.		78 Johnson.	"	
120 Burlington.	"				
Western Division			Connecticut and Passumpsic Railroad.		
0 St. Albans.	2 j. Potsdam Slate.		0 White Riv. Jun.	1 l. Hornblende Schist.	
9 Swanton.	"		5 Norwich.	"	
Northern Division.			10 Pompanoosuc.	"	
0 St. Albans.	2 j. Potsdam Slate.		15 Thetford.	2 c. and d. Coos Group.	
9 East Swanton.	"		22 Fairlee.	1 k Lyman Gp. & 1 c Hur	
17 Province Line.	3 b. Levis Limestone.		28 Bradford.	"	
Eastern Division.			36 Newbury.	"	
0 St. Albans.			40 Wells River.	"	
10 Sheldon.	1 c. Huronian.		51 Barnet.	2 c. Calcifer's Mich Sch.	
18 Enosburg Falls.	"		58 Passumpsic.	"	
28 Richford.	"		61 St. Johnsbury.	"	
Addison Division.			69 Lyndonville.	"	
0 Leicester Junc.	3 c. Chazy.		77 West Burke.	"	
3 Whiting.	"		90 Barton.	"	
7 Shoreham.	" and 3 a.		100 Coventry.	"	
9 Orwell.	2 c. Calcifer's Sandrock.		105 Newport.	2. Cambrian.	
15 Larabee's Point	4 a. Trent. & La Motte.		Saratoga and Champlain Railroad.		
16 Ticonderoga.	3 a. Calciferous s. s.		0 Rutland.		
Harlem Extension Railroad.			11 Castleton.	2. Cambrian Slates.	
0 Rutland.	2 a. Calcifer's Sandrock.		8 Granville.	"	
6 Clarendon.	"		19 Rupert.	"	
9 Wallingford.	"		26 Salem.	"	
13 S. Wallingford.	3 c. Chazy Marble.		34 Eagle Bridge.	"	
18 Danby and Mt. Tabor.	3 a. Calcifer's Sandstone.				
25 East Dorset.	" & Chazy Marble.				
30 Manchester.	3 b. Levis Limestone.				
39 Arlington.	"				
44 Shaftsbury.	"				
51 N. Bennington.	"				
55 Bennington.	"				
61 T. & B. Junc'n.	2. Cambrian Taconic sl.				

Massachusetts.

Eastern Railroad.		Boston and Maine Railroad.	
0 Boston.	20 a. Glacial Drift.	0 Boston.	20 a. Glacial Drift.
2 Somerville.	2. Cambrian.	12 Reading.	1 l. Hornblende Schists.
3 Everett.	"	18 Wilmington.	1 A. Laurentian.
5 Chelsea.	20 a. Glacial Drift.	23 Andover.	"
11 Lynn.	1 a. Huronian, (Porp'y)	26 South Lawrence	1 p. Merrimack Group.
16 Salem.	D d. Exeter Sienite.	32 Bradford.	"
23 Wenham.	"	38 Plaistow.	"
28 Ipswich.	"	41 Newton.	"
31 Rowley.	"	45 East Kingston.	"
37 Newburyport.	1 A. Laurentian.	51 Exeter.	D d. Exeter Sienite.
39 Salisbury.	D d. Exeter Sienite.	58 New Market.	"
43 Seabrook.	1 p. Merrimack.	68 Dover.	"
47 Hampton.	"	72 Salmon Falls.	1 p. Merrimack Group.
51 Greenland.	"	78 North Berwick.	"
56 Portsmouth.	"	85 Wells.	D d. Exeter Sienite.
58 Kittery.	"	90 Kennebunk.	2. Cambrian.
63 Elliott.	"	100 Saco.	"
67 Conway Junc'n.	"	109 Scarboro Beach.	1 A. Huronian.
70 So. Berwick J'n	"	116 Portland.	"
75 North Berwick.	"	Boston, Lowell and Nashua Railroad.	
80 Wells.	D d. Exeter Sienite.	0 Boston.	
89 Kennebunk.	2. Cambrian.	8 Winchester.	D d. Exeter Sienite.
94 Biddeford.	" and Con'y Gra'te.	15 Wilmington.	1 A. Laurentian.
95 Saco.	2. Cambrian.	22 Billerica.	"
103 Scarboro.	1 c. Huronian.	26 Lowell.	1 p. Merrimack Group.
108 Portland.	"	29 No. Chelmsford.	"
Boston, Salem and Rockport Division.		40 Nashua.	"
Beverly.	D d. Exeter Sienite.	45 Merrimack.	"
Manchester.	"	51 Milford.	1 g. Lake Gneiss.
Gloucester.	"	54 Wilton.	Rockingham Schists.
Rockport.	"	59 Lyndeboro.	1 g. Quartz Lake Gneiss
Amesbury Branch.		66 Greenfield.	1 g. Lake Gneiss.
39 Salisbury.	D d. Exeter Sienite.	Danvers and Newburyport Railroad.	
43 Amesbury. ⁶	20 a. Glacial Drift.	0 Boston.	
Great Falls, Rochester and Conway Branch.		10 Wakefield.	D d. Exeter Sienite.
73 Great Falls.	1 p. Merrimack Quartz.	13 Lynnfield.	"
79 Rochester.	2 b. Andalusite Schists.	19 Danvers.	"
109 Wolfboro.	1 g. Lake Gneiss.	28 Boxford.	1 l. Hornblende Schists.
138 North Conway.	1 b. Conway Granite.	31 Georgetown.	"
Salem and Lawrence Branch.		40 Newburyport.	1 A. Laurentian.
Salem.	Sienite and Diorite.	Old Colony Railroad.	
Middletown.	1 l. Hornblende Schists.	0 Boston.	
Lawrence.	1 p. Merrimack Group.	5 Neponset.	2. Cambrian.
		10 Braintree.	"
		15 Randolph.	D d. Exeter Sienite.
		19 Stoughton.	"
		25 Easton.	"
		31 Raynham.	14. Carboniferous.
		34 Taunton.	"
		43 Somerset.	Granite.

6. This and the adjoining towns are chiefly occupied by a profusion of lenticular-shaped drift-hills, believed to be moraines of ancient glaciers, and different from the usual *grand moraine* of glacial drift. The hills may be 200 feet high, and their longer axis run southeasterly, being parallel with the course of the striae in the neighborhood. In the Merrimack and Connecticut Valley a few have been found having a direction to the south and west-of-south, but agreeing with the course of adjoining striae.

Old Colony Railroad—Continued.
Ms. | Division.

15 Holbrook.	D d. Exeter Sienite.
20 Brockton.	"
27 Bridgewater.	14. Carboniferous.
34 Middleboro.	"
45 Assonet.	Granite.
49 Fall River.	14 a. Conglomerate.
56 Bristol Ferry.	14 b. Coal Measures.
68 Newport.	"

(Continued in Rhode Island.)

South Shore, Duxbury and Cohasset Division.

0 Boston.	
10 Braintree.	2. Cambrian.
11 Weymouth.	20 a. Glacial Drift.
17 Hingham.	D d. Exeter Sienite.
21 Cohasset.	"
39 Egypt.	"
Sea View.	"
37 Duxbury.	"
Plymouth.	20 a. Glacial Drift.
45 Fremont.	"
49 Wareham.	"
54 Cohasset Narr's	"
62 Sandwich.	"
69 W. Barnstable.	"
73 Barnstable.	"
75 Yarmouth.	"
84 Harwich.	"
94 Orleans.	"
106 Wellfleet.	"
120 Provincetown.	"
68 Falmouth.	"
71 Wood's Hole.	"

Boston, Clinton and Fitchburg Railroad.

0 Boston.	
22 S. Framingham.	1 A. Laurentian.
28 Fayville.	"
32 Marlboro.	1 1. Hornblende Schists.
41 Berlin.	1 p. Merrimack qu. & sch
48 Clinton.	2. Cambrian.
50 Pratt's Junction	1 p. Merrimack qu. & sch
59 Fitchburg.	Granite.

Fitchburg and Worcester Division.

0 Fitchburg.	
5 Leominster.	1 p. Merrimack qu. & sch
9 Pratt's Junction	"
14 Sterling June'n.	"
26 Worcester.	" & Granite.

Mansfield and Framingham Division.

0 Fitchburg.	
40 Sherborn.	D d. Exeter Sienite.
45 Medfield.	"
49 Walpole.	2. Cambrian.
58 Mansfield.	14 b. Coal Measures.
69 Taunton.	"
89 New Bedford.	1 A. Laurentian.

Boston, Clinton and Fitchburg—Continued.
Ms. | Framingham and Lowell Division.

0 Lowell.	1 p. Merrimack qu. & sch
13 Acton.	1 A. Laurentian.
20 Sudbury.	"
26 Framingham.	"

Boston and Providence Railroad.

0 Boston.	
5 Forest Hill.	20 a. Drift Moraine.
9 Readville.	1 c. Huronian Porphyry.
14 Canton.	2. Cambrian.
18 Sharon.	D d. Exeter Sienite.
24 Mansfield.	14 b. Coal Measures.
31 Attleboro.	"

New York and New England.

0 Boston.	
9 Readville.	1 c. Huronian Porphyry.
19 Walpole.	2. Cambrian.
23 Norfolk.	D d. Exeter Sienite.
27 Franklin.	"
30 Wadsworth.	1 A. Laurentian.
36 Blackstone.	"
41 Ironstone.	"
48 Douglas.	2 c. Quartzite.
53 E. Thompeon.	1 B. Montalban.

Norwich and Worcester Division.

0 Worcester.	1 p. Merrimack qu. & sch
4 Auburn.	"
11 Oxford.	"
16 Webster.	1 A. Laurentian.

Woonsocket Division.

0 Boston.	
12 Weedham.	2. Cambrian.
19 Medfield.	1 m. Huron'n Porphyry.
25 Medway.	D d. Exeter Sienite.
32 Bellingham.	1 c. Huronian.
38 Woonsocket.	2. Cambrian.

Nashua and Acton Railroad.

0 Nashua.	1 p. Merrimack qu. & sch
5 Dunstable.	1 g. Lake Gneiss.
12 Graniteville.	1 p. Merrimack qu. & sch
22 Acton.	1 A. Laurentian.
24 Concord June'n	"

Worcester and Nashua Railroad.

0 Worcester.	1 p. Merrimack qu. & sch
10 Oakdale.	"
17 Clinton.	2. Cambrian.
25 Harvard.	1 p. Merrimack qu. & sch
31 Groton.	"
39 Hollis.	"
46 Nashua.	"
57 Windham.	"
65 Sandown.	"
74 Epping.	"
80 Lee.	"
88 Barrington.	"
95 Rochester.	2 b. Andalusite Schists.
147 Portland.	1 c. Huronian.

Ms. | Providence and Worcester R. R.

16 Woonsocket.	2. Cambrian.
20 Millville.	"
25 Uxbridge.	1 A. Laurentian.
31 Northbridge.	"
37 Millbury.	"
44 Worcester.	"

Boston, Barre and Gardner Railroad.

0 Boston.	
44 Worcester.	1 p. Merrimack qu. & sch
52 Holden.	"
60 Princeton.	1 g. Lake Gneiss.
70 Gardner.	"

Ware River Railroad.

0 Palmer.	1 d. Porphyritic Gneiss.
3 Thorndike.	"
12 Ware.	"
21 Barre Plaines.	1 g. Lake Gneiss.
27 Templeton.	"
43 Baldwinville.	"
48 Winchendon.	"

Springfield, Athol & North-Eastern R. R.

0 Athol.	1 g. Lake Gneiss.
8 New Salem.	"
16 Greenwich Vill'e	"
21 Enfield.	"
30 Barrett's Junc'n	D d. Sienite.
37 Collins.	"
41 Ludlow.	" & 16. Triassic.
48 Springfield.	16. Triassic.

New London Northern Railroad.

50 Stafford.	1 B. Montalban.
60 South Monson.	"
65 Palmer.	1 d. Porphyritic Gneiss.
70 Barrett's.	D d. Sienite.
75 Belchertown.	1 B. Montalban.
80 Dwight's.	20 a. Drift.
85 Amherst.	16. Triassic.
90 Leverett.	1 B. Montalban.
95 South Montague	16. Triassic.
100 Miller's Falls.	1 B. Montalban.
103 Northfield.	16. Triassic.
110 South Vernon.	2 c. Coos Quartzite.
116 Vernon.	1 e. Bethlehem Gneiss.
121 Brattleboro.	2. Cambrian.

Ms. | New Haven and Northampton R. R.

0 Williamsburg.	Calcliferous Mica Schist.
5 Florence.	D d. Sienite.
8 Northampton.	"
13 East Hampton.	16. Triassic.
16 Southampton.	"
23 Westfield.	"
29 Southwick.	"

Connecticut River Railroad.

0 Springfield.	16. Triassic.
7 Chicopee Jun'n.	"
8 Holyoke.	"
13 Smith's Ferry.	"
15 Mount Tom. ⁷	"
17 Northampton.	D d. Sienite.
21 Hatfield.	16. Triassic.
26 Whately.	"
33 Deerfield.	"
36 Greenfield. ⁸	"
40 Bernardstown. ⁹	2 c. Quartzite and Coos.
50 South Vernon.	"

New Haven, Hartford & Springfield R. R.

0 Springfield.	16. Triassic.
4 Long Meadow.	"

Housatonic Railroad.

0 Pittsfield.	3 b. & c. Stockbridge ls.
7 Dewey's.	"
8 Lenox.	"
11 Lee.	"
17 Stockbridge.	"
23 Van Deusenville	"
25 Barrington.	"
31 Sheffield.	"
35 Ashley Falls.	"
37 Canaan.	"

Fitchburg, Troy and Boston Railroad.

0 Boston.	
10 Waltham.	1 c. Huronian.
20 Concord.	1 A. Laurentian.
27 West Acton.	"
35 Ayer Junction.	1 p. Merrimack qu. & sch
40 Shirley.	"
46 Leominster.	"
50 Fitchburg.	"
58 Westminster.	Granite.

7. This is the locality furnishing for the Amherst Museum the large rows of tracks of *Brontozoum Giganteum*, the largest of the Triassic birds. Across the river, in South Hadley, is an excellent locality of *Otozoum Moodii*, so named for Pilny Moody, who was the first person in the Connecticut Valley known to have observed any of the footmarks. A specimen is preserved which he dug up in 1800, saying that "the tracks were made by Noah's raven."

8. The noted locality of fossil footmarks is at Turners Falls, on a branch of the F. T. & B. R. R., four miles distant. W. W. Draper was the first person to observe them, in 1835. He suggested that they were "turkey tracks made 2,000 years ago." His impressions were communicated to Col. Wilson, who called the attention of Dexter Marsh to them. Mr. Marsh showed them to Dr. James Deans, who requested Prof. E. Hitchcock to investigate them scientifically. This was done, and the results accumulated in the Hitchcock Ichnological Museum at Amherst, where are over 30,000 separate ichnites, illustrating about 160 species, all from the Connecticut Valley.

9. This is the town where the celebrated Helderberg limestone crops out. It is believed to be a remnant of a once extensive deposit, preserved accidentally from erosion, and resting upon & folded beneath the Coos Quartzite.

Fitchburg, Troy & Boston R. R.—Continued.		Boston and Albany Railroad—Continued.	
60 Ashburnham.	1 g. Lake Gneiss.	67 Brookfield.	1 g. Lake Gneiss.
65 Gardner.	1 B. Montalban.	73 Warren.	"
71 Baldwinville.	"	83 Palmer.	1 d. Porph. Gneiss.
77 Royalston.	"	89 Wilbraham.	16. Triassic.
80 Athol.	"	98 Springfield.	"
87 Orange.	"	108 Westfield.	"
92 Ewing.	"	116 Russell.	2 e. Calcifer's Mica Sch.
98 Miller's Falls.	"	119 Huntington.	"
102 Montague.	"	126 Chester.	1 c. Huronian.
106 Greenfield. ⁸	16. Triassic.	131 Middlefield.	"
109 Bardwell's.	"	135 Becket.	1 f. Green Mt. Gneiss.
117 Shelburne Falls.	1 f. Green Mt. Gneiss.	138 Washington.	"
128 Charlemont.	"	143 Hinsdale.	"
132 Zoar.	"	146 Dalton.	2 j. Potsdam.
136 Hoosac Tunnel.	10 " "	151 Pittsfield.	3 b. & c. Stockbridge ls.
143 North Adams.	3 b. & c. Stockbridge ls.	159 Richmond.	"
148 Williamstown.	"	162 State Line.	2 g. Taconic Schists.
158 Petersburg.	2 g. Taconic Schists.		
Boston and Albany Railroad.		Milford Branch.	
0 Boston.		S. Framingham.	1 A. Laurentian.
5 Brighton.	2. Cambrian.	Milford.	"
21 S. Framingham.	1 A. Laurentian.	Pittsfield and North Adams Branch.	
28 Southville.	"	0 Pittsfield.	3 b. & c. Stockbridge ls.
38 Grafton.	"	6 Berkshire.	"
49 Worcester.	1 p. Merrimack qu. & sch	10 Cheshire.	"
52 Rochdale.	1 g. Lake Gneiss.	15 South Adams.	"
62 Spencer.	"	20 North Adams.	"

10. The mountain is believed to be an inverted and very much crushed anticlinal.

Rhode Island.

Ms. Providence and Springfield Railroad.		Providence, Warren and Bristol Railroad.	
0 Providence.	14. Carboniferous.	0 Providence.	14. Carboniferous.
5 Allendale.	1 D. Huronian.	7 Nayatt.	"
10 Stillwater.	1 A. Laurentian.	10 Warren.	"
17 Tarkiln.	"	14 Bristol.	"
23 Pascoag.	"	16 Fall River.	14 a. Carb. Conglom'te.
Providence and Worcester Railroad.		Old Colony Railroad.	
0 Providence.	14. Carboniferous.	0 Newport.	14 b. Coal Measures.
6 Valley Falls.	14 b. Coal Measures.	12 Bristol Ferry.	"
9 Ashton.	2. Cambrian.	14 Tiverton.	Granite.
16 Woonsocket.	" ?	19 Fall River.	14 a. Carb. Conglom'te.
Boston and Providence Railroad.			
0 Providence.	14. Carboniferous.		
4 Pawtucket.	14 b. Coal Measures.		
5 East Junction.			

Connecticut.

Housatonic Railroad.		New Haven & Northampton R. R.—Con. Collinsville Branch.	
0 Bridgeport.	1 d. Porphyritic Gneiss.	Farmington.	16. Triassic.
10 Stepney.	1 B. Montalban.	Unionville.	"
15 Botsford.	"	Collinsville.	1 B. Montalban.
19 Newtown.	"	New Hartford.	"
23 Hawleyville.	"	New York, New Haven, Hartford & Springfield Railroad.	
27 Brookfield Jun.	"	0 New York.	1 B. Montalban.
35 New Milford.	"	30 Greenwich.	"
42 Merwinsville.	"	35 Stamford.	"
48 Kent. ¹¹	1 A. Laurentian.	43 South Norwalk.	"
57 Cornwall Bridge	"	50 Southport.	"
65 Lime Rock.	3 b. & c. Stockbridge l.s.	57 Bridgeport.	1 d. Porphyritic Gneiss.
73 Canaan.	"	60 Stratford.	"
Shepaug Railroad.		65 Milford.	2 e. Calcifer's Mica Sch.
0 Litchfield.	1 b. Montalban.	74 New Haven.	16. Triassic.
6 Morris.	"	80 North Haven.	"
13 Washington.	"	86 Wallingford.	"
20 Roxbury.	"	92 Meriden.	"
32 Hawleyville.	"	99 Berlin.	"
38 Bethel.	"	105 Newington.	"
59 South Norwalk.	"	110 Hartford.	"
Naugatuck Railroad.		116 Windsor.	"
0 Bridgeport.	1 d. Porphyritic Gneiss.	122 Windsor Locks.	"
3 Stratford.	"	127 Thompsonville.	"
13 Derby.	"	136 Springfield.	"
15 Ansonia.	"	Shore Line Division.	
19 Seymour.	1 B. Montalban.	0 New Haven.	16. Triassic.
26 Naugatuck.	"	8 Branford.	1 A. Laurentian.
32 Waterbury.	"	16 Guilford.	1 B. Montalban.
34 Waterville.	"	23 Clinton.	"
41 Thomaston.	"	28 Westbrook.	"
46 Campville.	"	31 Saybrook.	"
49 Litchfield.	"	33 Lyme.	1 A. Laurentian.
52 Wolcottville.	"	43 East Lyme.	"
57 Burrville.	1 A. Laurentian.	50 New London.	"
61 Winsted.	"	Connecticut Central Railroad.	
32 Waterbury.	1 B. Montalban.	Hartford.	16. Triassic.
35 Oakville.	"	South Windsor.	"
38 Watertown.	"	Melrose.	"
New Haven and Northampton Railroad.		Hazardville.	"
0 New Haven.	16. Triassic.	Connecticut Valley Railroad.	
9 Mount Carmel.	"	0 Hartford.	16. Triassic.
15 Cheshire.	"	8 Rocky Hill.	"
22 Southington.	"	15 Middletown.	"
27 Plainville.	"	24 Higganum.	1 A. Laurentian.
31 Farmington.	"	30 Goodspeed.	1 B. Montalban.
37 Avon.	"	38 Essex.	"
42 Simsbury.	"	44 Saybrook Point.	"
47 Granby.	"		

11. The oldest formations of New England assume ovoidal shapes, as the area of Laurentian, near Kent, and Winsted, Ct., Vernon, Vt., Winchester, N. H., &c. The later series are grouped concentrically around them, and thus an easy way of determining age and inversion is afforded.

Ms. New London Northern Railroad.		Ms. Hartford, Providence & Fishkill R. R.	
0 New London.	1 A. Laurentian.	0 Waterbury.	1 B. Montalban.
6 Montville.	"	11 Terryville.	"
13 Norwich.	1 B. Montalban.	19 Plainville.	16. Triassic.
20 Franklin.	"	24 New Britain.	"
26 South Windham	"	33 Hartford.	"
30 Willimantic.	"	42 Manchester.	"
36 Eagleville.	"	49 Vernon.	1 B. Montalban.
44 Tolland.	"	56 Andover.	"
50 Stafford.	"	65 Willimantic.	"
Stonington and Providence Railroad.		75 Baltic.	"
0 New London.	1 A. Laurentian.	88 Plainfield.	"
9 Mystic.	"	(Rhode Island.)	
12 Stonington.	"	91 Moosup.	1 A. Laurentian.
(Rhode Island.)		96 Oneco.	"
18 Westerly.	1 A. Laurentian.	101 Summit.	"
26 Wood Riv. Jun.	"	109 Washington.	"
35 Kingston.	"	114 Natick.	"
42 Wickford Junc.	"	123 Providence.	14. Carboniferous.
48 Greenwich.	14. Carboniferous.	New York and New England R. R.	
53 Hill Grove.	"	0 Willimantic.	1 B. Montalban.
57 Auburn.	"	9 Goshen.	"
62 Providence.	"	20 Pomfret.	"
Connecticut Western Railroad.		25 Putnam.	"
0 Hartford.	16. Triassic.	29 Thomson.	"
6 Bloomfield.	"	33 East Thomson.	"
12 Tariffville.	"	Norwich and Worcester Division.	
15 Simsbury.	"	0 New London.	1 A. Laurentian.
22 Canton.	1 B. Montalban.	13 Norwich.	1 B. Montalban.
24 Collinsville.	"	23 Jewett City.	"
29 New Hartford.	"	29 Plainfield.	"
36 Winsted.	1 A. Laurentian.	34 Wauregan.	"
45 Norfolk.	"	42 Daysville.	"
55 Canaan.	3 b. & c. Stockbridge ls.	47 Putnam.	"
62 Salisbury.	"	52 Grosvenor Dale.	"
69 Millerton.	"	57 Webster.	"

New York.¹By JAMES MACFARLANE.²

GEOLOGICAL FORMATIONS OF THE STATE OF NEW YORK.

FORMATIONS AND SUB-DIVISIONS.		FORMATIONS AND SUB-DIVISIONS.							
Devonian.	20. Quaternary.	Silurian.	8. Oriskany.						
	16. Triassic.		7. Lower Helderberg.*						
	12. Catskill.		6. Waterlime.						
	11 b. Chemung.		6. Salina or Onondaga Salt group.						
	11 a. Portage, {		5 c. Niagara.						
			5 b. Clinton.						
	10 c. Genesee.	5 a. Medina, {	2. Medina sandstone.						
	10 b. Hamilton, {	Cambrian.	} 1. Oneida Conglom.						
				10 a. Marcellus.					
	9 c. U. Helderberg, {				4 c. Hudson River, {	} 3. Lor. sha.			
9 a. Cauda Galli.				4 a. Trenton, {			} 2. Fra'kfort sh. & s.s.		
								3 c. Chazy.	} 4 b. Utica.
3 a. Calciferous.	} 2. Blk. River l. s.								
2 b. Potsdam.		} 1. Birdseye l. s.							
	} Middle Cambrian.								
		} Lower Cambrian.							
	Primary.			1 d. Montalban.					
		1 c. Norian.							
		1 a. Laurentian.							

* Consisting in the ascending order of : 1, the Tentaculite limestone ; 2, Pentamerus limestone ; 3, Delthyris shaly limestone ; 4, Encrinural limestone ; and 5, Upper Pentamerus limestone.

* Consisting in the ascending order of: 1, the Tentaculite limestone; 2, Pentamerus limestone; 3, Delthyris shaly limestone; 4, Encrinural limestone; and 5, Upper Pentamerus limestone.

³ The right hand marginal figures in the column of formations denote the elevations of the railroad stations in feet above tide water.

1. The State of New York is to the geologist what the Holy Land is to the Christian, and the works of her Palaeontologist are the Old Testament Scriptures of the science. It is a Laurentian, Cambrian, Silurian and Devonian State, containing all the groups and all the formations of these long ages, beautifully developed in belts running nearly across the State in an east and west direction, lying undisturbed as originally laid down. Railroads running north and south pass over a number of the formations in short distances, while those running east and west run for long distances on the same formation, as for example the N. Y. C. & H. R. R. on the 6. Salina, and the Erie Railway on the 11 b. Chemung. In the eastern part of the State the formations are more irregularly disposed. New York localities are those to which we must always go back as the standard by which any disputed formation of these ages is to be tested.

2. The author has bestowed more of his own labor and research on the local geology of this State, than on any other, having besides diligent study of all the official reports, made personal observations of the exposures of the formations in traveling for many years on all the railroads. It was from making geological notes on the margin of railroad time tables that he conceived the idea of this geological railway guide book for the State, and by calling in the aid of scientific gentlemen of other States, he has been enabled to extend it over the whole United States and Canada. To Prof. James Hall, of Albany, the State Geologist, he is indebted for much information and important corrections in the table of formations and as to some of the localities in this State.

3. N. Y. C. & H. R. R. GRADES CAUSED BY GEOLOGICAL STRUCTURE.—This railroad undoubtedly occupies the finest locality for an east and west railroad in the United States. From New York to Albany the road is level, tide water extending to Troy, the Hudson River being in fact an estuary. From Albany to Schenectady there is an ascent of 200 feet, Little Falls is 368, Rome 439 feet, and Batavia (the highest station) 887 feet above tide. It has no heavy grades on its main line except at Albany and in the trough of the Genesee at Rochester. It owes its advantages to geological structure, the outcrop of the formations running east and west, and the Salina or Onondaga, Utica and Hudson River soft shales are cut into low valleys through which the railroad and Erie Canal are built. If the formations had run north and south, as they do in Pennsylvania, Maryland, &c., and been turned up edgewise, the hard sandstones would have been high ridges and

New York Central and Hudson River Rail- road.		New York Central & Hudson River Rail- road—Continued.	
Ms.		Ms.	
0 New York. ⁴	1 d. Montalban, 37 ms.	34 Croton.	1 d. Montalban.
11 Spuyten Duyil.	"	37 Crugers.	1 a. Lower Laurentian,
12 Riverdale. ⁵	"	38 Montrose. ⁶	" 20 miles.
13 Mt. St. Vincent.	"	41 Peekskill.	"
15 Yonkers.	"	45 { Ft. Montgom- ery. Highlands. Garrison's. (West Point.)	The Highlands.
19 Hastings.	"		
20 Dobb's Ferry.	"		
22 Irvington.	"		
25 Tarrytown.	"	49 {	"
29 Scarborough.	"	52 Cold Spring.	"
30 Sing Sing. ⁵	"	54 Cornwall. ⁶	"

perhaps mountains to be overcome, as they are everywhere from the Mohawk Valley to Alabama. If even the limestone ridge of the Helderberg range, which bounds this valley on the south, had taken a northern direction, as the 2-4. Cambrian formations do, a tunnel would probably have been necessary. In the western part of the State these Helderberg limestones continue, but not as a prominent ridge. The road via Geneva, runs on them at Auburn, Clifton Springs, &c., but with less favorable grades than the direct road, and at Buffalo they are level with the plain. It should be added that the old Laurentian mountains at Little Falls and at Peekskill have been cloven from top to bottom, thus opening the gateways for the traffic and travel of the West. The popular impression that New York is a level plain like the prairies of the West, derived from traveling on the N. Y. C. & H. R. R. R., is altogether erroneous. There is only a narrow trough through the centre of the State, in which the railroad and canal are located, that is of this level character.

4. New York island is 12 miles long and nearly 2 miles wide. The widest point is two and one-quarter miles at 14th St. Below Grand street it gradually becomes narrower as well as at the north end. The lower part of the city, below Wall street, is half a mile wide. The rock of the island is gneiss, except a portion of the north end, which is limestone. The south portion is covered with deep alluvial deposits, which in some places are more than 100 feet in depth. The natural outcropping of the gneiss appeared on the surface about 16th street, on the east side of the city, and run diagonally across to 31st street on 10th Avenue. North of this, much of the surface was naked rock. It contains a large proportion of mica, a small proportion of quartz and still less feldspar, but generally an abundance of iron pyrites in very minute crystals, which, on exposure, are decomposed. In consequence of these ingredients it soon disintegrates on exposure, rendering it unfit for the purposes of building. The erection of a great city, for which this island furnishes a noble site, has very greatly changed its natural condition. The geological age of the New York gneiss is undoubtedly very old, not the 1 a. Laurentian or oldest, nor the 1 b. Huronian, but it belongs to the third or White Mountain series, named by Dr. Hunt the 1 c. Montalban. It is the same range which is the basis rock of nearly all the great cities of the Atlantic coast. It crosses New Jersey where it is turned to clay, until it appears under Trenton, and it extends to Philadelphia, Baltimore, Washington and Richmond, Va., and probably Boston, Massachusetts, is founded on this same formation.

5. On the opposite side of the river may here be seen for many miles the Palisades, a long, rough mountain ridge close to the water's edge. Its upper half is a perpendicular precipice of bare rock of a columnar structure from 100 to 200 feet in height, the whole height of the mountain being generally from 400 to 600 feet, and the highest point in the range opposite Sing Sing 1011 feet above the Hudson, and known as the High Top. The width of the mountain is from a half mile to a mile and a half, the western slope being quite gentle. In length it extends from Bergen Point below Jersey City to Haverstraw, and then westward in all 48 miles, the middle portion being merely a low ridge. The lower half of the ridge on the river side, is a sloping mound of detritus, of loose stones which has accumulated at the base of the cliff, being derived from its weathered and wasted surface. This talus and the summit of the mountain are covered with trees, with the bare rocky precipice called the Palisades between, and many fine country residences may be seen on the level summit, from which are beautiful views of the river, the harbor and City of New York. Viewed from the railroad or from a steamboat on the river, this lofty mural precipice, with its huge weathered masses of upright columns of bare rock, presenting a long, straight unbroken ridge overlooking the beautiful Hudson River, is certainly extremely picturesque. Thousands of travelers gaze at it daily without knowing what it is. This entire ridge consists of no other rock than trap traversing the 16. Triassic formation in a huge vertical dike. The red sandstone formation of New Jersey is intersected by numerous dikes of this kind, but this is much the finest. The materials of this mountain have undoubtedly burst through a great rent or fissure in the strata, overflowing while in a melted or plastic condition the red sandstone, not with the violence of a volcano, for the adjoining strata are but little disturbed in position, although often greatly altered by the heat, but forced up very slowly and gradually, and probably under pressure. Subsequent denudation has laid bare the part of the mountain now exposed along the river. The rock is columnar basalt, sometimes called greenstone, and is solid, not stratified like water formed rocks, but cracked in cooling and of a crystalline structure. (See description of the 16. Triassic formation and its Trap Dikes). Here is a remarkable but not uncommon instance of a great geological blank. On the east side of this river the formations belong to No. 1, the first or oldest series of Primary or Crystalline rocks, while on the west side they are No. 16, all the intermediate Cambrian, Silurian, Devonian and Carboniferous formations being wanting. This state of things continues all along the Atlantic coast to Georgia, the 18. Cretaceous or 17. Jurassic taking the place of the 16. Triassic farther south.

6. 38 Montrose to 54 Cornwall. This celebrated passage of the Hudson through the Highlands, is a gorge nearly 20 miles long from 8 miles south of Peekskill to Fishkill, and is worn out of the 1 a. Laurentian rocks far below mean tide water. The hills on its sides rise in some instances as much

New York Central & Hudson River Railroad—Continued.			New York Central & Hudson River Railroad—Continued.		
Ms.			Ms.		
57	Dutchess and Columbia Junction.	2 Lower and 3 Middle Cambrian or 3 b. Quebec group, 26 miles.	142	Albany. ¹⁰	4 c. Hudson River, 27 m
58	Fishkill. ⁷	"	145	West Albany. ¹¹	"
62	Low Point.	"	160	Schenectady. ¹¹⁹	" 287
64	New Hamburg.	"	169	Hoffman's Ferry	4 b. Utica, 7 miles. 288
69	Milton Ferry.	"	174	Crane's Village.	" 288
73	Poughkeepsie.	"	176	Amsterdam. ¹²	4 a. Trenton, 10 ms. 271
78	Hyde Park.	"	182	Tribes Hill.	" quarries, 1 m.
83	Staatsburg.	"	187	Fonda. ¹⁸	4 b. Utica, 5 miles. 291
88	Rhinebeck. ⁸	4 c. Hudson River, 65 m	192	Yost's. ¹⁴	{ Two bluffs or noses of Calcif. on Laur'n.
94	Barrytown.	"	195	Sprakers. ¹⁴	{ 3 a. Calciferous hill. Laur'n at R.R. track.
98	Tivoli.	"	198	Palatine Bridge.	{ 4 a. Trenton, 3 miles. Hills to north Calcif.
104	Germantown.	"	200	Fort Plain. ¹⁵	{ 4 a. Trenton, 18 ms. & Hudson River. 295
107	Livingston.	"	206	St. Johnsville.	" 311
109	Catskill.	"	209	East Creek.	" 328
114	Hudson. ⁹	"	216	Little Falls. ¹⁷	1 a. Laurentian, 1 m. 288
118	Stockport.	"	223	Herkimer.	4 b. Utica, 28 miles. 290
121	Coxsackie.	"	225	Ilion.	" 292
123	Stuyvesant.	"	227	Frankfort.	" 294
129	Schodack.	"	237	Utica. ¹⁸	" 408
133	Castleton.	"	241	Whitesboro. ¹⁹	" 407
142	East Albany.	"	244	Oriskany. ²⁰	4 c. Hudson River, 8 m
142	Albany. ¹⁰	"			
148	Troy. ¹⁰	" 25			

as 2600 feet, and in many places the walls are very precipitous. The rock is gneiss, of a kind that is not easily disintegrated or eroded, nor is there any evidence of any convulsive movement. It is clearly a case of erosion, but not by the present river, which has no fall, for tide water extends 100 miles up the river beyond the Highlands. This therefore was probably a work mainly performed in some past period when the continent was at a higher level. Most likely it is a valley of great antiquity. Also see notes 17 and 118.

7. Opposite Fishkill is Newburg, which is in the great valley of Lower Silurian or Cambrian limestone and slate. North of that, on the west side of the river, the formations occur in their usual order, their outcrops running northeast and southwest. On the N. Y. C. & H. R. R. R., on the east side, the same valley crosses, and the slates from Fishkill to Rhinebeck are about the same place in the series; but being destitute of fossils and very much faulted, tilted and disturbed, their precise geology is uncertain. See the exposures in the cuts at Poughkeepsie. The high ground to the east is commonly called the Quebec group. See notes 116 and 117.

8. Rhinebeck. A series of great dislocations with upthrows on the east side traverse eastern North America from Canada to Alabama. One of these great faults has been traced from near the mouth of the St. Lawrence River, keeping mostly under the water up to Quebec just north of the fortress, thence by a gently curving line to Lake Champlain or through Western Vermont across Washington County, N. Y., to near Albany. It crosses the river near Rhinebeck 15 miles north of Poughkeepsie and continues on southward into New Jersey and runs into another series of faults probably of a later date, which extend as far as Alabama. It brings up the rocks of the so called 3 b. Quebec group on the east side of the fracture to the level of the 4 c. Hudson River and 4 a. Trenton l. s.

9. Catskill Mountains. For many miles on this railroad are beautiful views of the Catskill Mountains, 3,000 feet high, (12. Catskill,) several miles distant on the opposite or west side of the river, and which furnish the name for the Catskill formation. The wide valley between them and the river is composed of 11 b. Chemung, 10. Hamilton, 7. Lower Helderberg and 4 c. Hudson River. The geology on the east or railroad side is entirely different.

10. Albany. The clay beds at Albany are more than 100 feet thick, and between that city and Schenectady they are underlaid by a bed of sand that is in some places more than 50 feet thick. There is an old glacial clay and boulder drift below the gravel at Albany, but Professor Hall says it is not the estuary stratified clay. At the south end of the city of Troy the gravel and sand beds are subject to dangerous land slides.

11. The distant mountain to the southwest is the Helderberg range. See notes 24 and 41.

12. Amsterdam. Precipice of 4 a. Trenton limestone back of the town, and quarries at the track. For 40 miles to Little Falls the railroad runs on Trenton limestone 3 a. Calciferous, 4 b. Utica and 4 c. Hudson River irregularly alternating.

13. Branch railroad north to Johnstown and Gloversville, in a valley of Utica slate.

14. Between Fonda and Palatine Bridge are fine bluffs of 3 a. Calciferous. The talus of fragments of rock at the foot of the precipice whiten out in weathering like the stones about an old lime-kiln. It is from the cavities of the Calciferous that the beautiful quartz crystals are produced, of which great quantities have been found. A similar bluff on south side of river. No Potsdam here.

15. The railroad skirts along the base of a ridge of Trenton limestone here and at Fort Plain.

16. At Fort Plain village the transition from the Birdseye to the Trenton limestone is to be seen, the first layers of the latter being of a drab color.

17. At Little Falls for one mile is a rare opportunity of seeing the 1 a. Laurentian formation.

New York Central & Hudson River Rail- road—Continued.		New York Central & Hudson River Rail- road—Continued.	
251 Rome. ²¹	4 c. Hudson River. ⁴⁵⁹	273 Canaseraga.	{ 6. Salina or Onondaga Salt group. ⁴¹¹
255 Green's Cors. ²²	5 a. Medina, 2 miles. ⁴⁵⁸	275 Chittenango.	" ⁴¹⁰
239 Verona. ²³	4 b. Clinton, 9 miles. ⁴⁶⁰	279 Kirkville.	" ⁴¹⁶
264 Oneida. ²⁴	4 c. Niagara, 3 ms. ⁴⁵²	282 Manlius.	" ⁴⁰⁹
267 Wampsville. ²⁵	"	289 Syracuse. ²⁷	" ³⁹⁵
269 Canastota. ²⁶	{ 6. Salina or Onondaga Salt group, 23 ms. ⁴²⁹	The railroad via Auburn is better than the Direct road to Rochester for geological observation.	

being a gorge cut by the Mohawk River through a spur of the Adirondack Mountain, which here crosses the railroad. You are now on the bottom rocks of the geological series, for nothing older has ever been found beneath them. The scenery has suddenly changed, and nothing is seen but bare, weatherworn precipices of crystalline rocks, from which all the elements through all the ages, have failed to produce a soil, yet a certain strange interest is attached to them. The oldest picture in the world, the oldest statue or other work of art, would excite the greatest attention, yet what are these in antiquity compared with these grand old Laurentian rocks, the oldest formation and the oldest dry land on the face of the earth, dating far back of the first appearance of either animal or vegetable life of any kind on our planet. The river channel through these rocks is an unequivocal example of river erosion, as pot-holes are found at various heights. See also notes 6 and 56.

18. Utica. The 4 b. Utica slate was named from this city. To study the Trenton, Black River and Birdseye limestones at their original, historical localities, change cars at Utica and go up the Utica and Black River Railroad to Trenton Falls. (See the within guide for that railroad). You can then go on to Watertown on these limestones. Return by the Rome, Watertown & Ogdensburg Railroad to Rome or Syracuse, examining the Lorraine shales at Adams and Pulaski.

19. From here to Syracuse there is no lock in the canal. This long level is 427 feet above tide.

20. Oriskany. The formation of this name, is not exposed here, but at Oriskany Falls on the D. L. & W. R. R. from which the name is derived. The best fossils of it are found east of Union Springs in Cayuga County. Along the part of the road east of Oriskany, the Utica shale forms the bottom of the valley. The south wall of the valley consists of the outcrops of the 4 c. Hudson River, 5 a. Oneida Conglomerate, 5 b. Clinton, the 6. Waterlime and 9. Upper Helderberg.

21. Rome. No more 2-4. Cambrian formations west of this in New York. From Rome to Buffalo and from Lake Ontario south to the Pennsylvania line all the formations are 5-11. Silurian and Devonian, and they are finely displayed in numerous gorges, ravines, canons and precipices, very regularly disposed in belts of outcrop running east and west. The typical localities from which most of the formations were named, are situated in this district. It is all historical geological ground, and you can scarcely go amiss in looking for fossils.

22. West of Little Falls the lower formations pass abruptly to the north and cross under Lake Ontario into Canada. The 4 c. Hudson River first crosses the valley, and then the Oneida conglomerate. Other rock formations now appear between Rome and Oneida, which had no existence in the basin east of Little Falls. These are the 5 a. Medina and Clinton, which overlie the Oneida, and form all the south shore of Lake Ontario, and extend across Canada West. Also 5 c. Niagara and the 6. Salina or Onondaga salt group, on which the N. Y. C. & H. R. R. runs from Oneida nearly to Rochester. The non-existence of these extensive formations east of Little Falls (the 5 a. Medina, 5 b. Clinton, 5 c. Niagara and 6. Salina), which cover the best part of Western New York, must be owing to the two parts of the State being separated in these early ages by the old Laurentian ridge at Little Falls into separate basins, in which the rock-forming conditions were different.

23. Verona. The Clinton fossil iron ore crops out on the railroad, but not of a good quality.

24. Oneida. The prominent ridge bounding the valley on the south of Utica, Oneida and Syracuse, called Stockbridge Hill, Pompey Hill, Cazenovia Hill and Onondaga Hill, is the Helderberg range, a continuous mountain 800 feet high, forming the back-bone of the State, and composed at its base of the 6. Waterlime, of the Salina group, all the members of the 7. Lower Helderberg being wanting as well as the 8. Oriskany sandstone and other sandstones that separate the Lower and Upper Helderberg, except a mere trace. On the Waterlime rests the Onondaga limestone, the most valuable building stone, and above this the Corniferous. Over these three great limestone formations is always found the 10 a. Marcellus shales, the 10 b. Hamilton and 10 c. Genesee, forming the fine fertile country extending south from this ridge. Still farther south is the 11 a. Portage with its glens, gorges and precipices, and 11 b. Chemung, extending to the Pennsylvania State line. The Oneida conglomerate, which is 30 or more feet thick in Herkimer and Oneida, gradually attenuates in going west, being a grey band, from 4 to 5 ft. thick at Rochester. It was named from Oneida county.

25. Wampsville. Numerous fragments of Niagara limestone are seen mixed with the soil, showing its existence underneath. The Niagara limestone and shales which, at Niagara, Lockport and Rochester are 150 feet thick, thin out in going eastward, being only two or three ft. thick at Saquoit Creek near Utica.

26. Canastota. Stop off and take the branch railroad to Cazenovia, rising 750 feet in 15 miles. Fine geological sections of 6. Salina with gypsum beds, 9. Upper Helderberg and 10 b. Hamilton. Magnificent view across Oneida Lake and a beautiful village and lake at Cazenovia.

27. Syracuse. Onondaga Lake, which is in sight and on the north side of the railroad at the west end of Syracuse City, is 5 miles long, 1 mile wide; its greatest depth is 60 feet, and its surface is 363 feet above tide water. It is excavated in the red shale of the (6.) Salina formation. The lake is what remains of an ancient much more extensive and deeper excavation, all of which has been filled in with sand, gravel and rolled stones, except the part occupied by the lake. The bottom and sides of the lake are covered with lake marl six feet thick. The ancient excavation underneath answers an excellent purpose as a reservoir into which the salt waters are received and retained, and the marl of the bottom of the lake serves an equally good purpose by separating the fresh water of the lake from the salt water stored away in the basin or reservoir of sand and gravel beneath. There could be no better material for the purpose. Into this basin the various borings

New York Central & Hudson River Railroad—Continued.			New York Central & Hudson River Railroad.		
Ms.	Old Road, via Auburn.		Ms.	Old Road, via Auburn—Continued.	
289 Syracuse. ²⁷	6. Salina, 9 miles.	395	346 Oaks Corners. ³¹	9 c. Cornifer's l.s., 18 m	
298 Camillus.	"		349 Phelps.	"	
300 Marcellus. ²⁸	" Gypsum beds.		353 Clifton Sprgs. ⁴⁶	"	618
303 Half Way.	9 c. Upper Helderberg,		358 Shortsville.	"	
307 Skaneateles. ²⁹	or Cornifer. 14 m.	610	364 Canandaigua.	10. Hamilton, 6 ms.	778
310 Sennett.	"		368 Paddleford.	"	
316 Auburn. ³⁰	"		369 Farmington.	"	
321 Aurelius.	{ Quarries of Corn. l.s.	715	370 W. Farmington.	{ 9 c. Corniferous l. s.	
326 Cayuga. ⁷⁸	6. Salina, 10 miles.			and Salina.	
331 Seneca Falls.	" (Lake ²⁷⁶)		374 Victor.	"	
334 Waterloo.	9 c. Corniferous l.s. 8 m		379 Fisher's.	9 c. Salina, 11 miles.	
	9 c. Seneca limestone.		384 Pittsford.	"	
	{ Deep drift overlying		388 Brighton.	5 c. Niagara, 4 miles.	
341 Geneva. ³¹	6. Salina and 9 c.		392 Rochester. ³⁶	"	488
	Corniferous l.s.	452			

of the salt wells are made, not through or into rock, but only through the lake marl and other loose material mentioned, to a depth of 150 to 450 ft. No rock salt or bed of salt has ever been discovered in this State, although it has been in Canada; but in this Salina formation are two porous or Vermicular masses of limestone, looking as if perforated by little worms, and hence the name; and between them are certain hopper shaped cavities in the shale in which, as well as in the perforations of these limestones, salt in a crystalline and solid state, it has been conjectured, formerly existed, the saline materials of which have been dissolved in water which percolated through the formation and passed into the basin where it is now found, the bed of marl on which is Onondaga Lake, being afterwards formed over it. But the origin of the salt water may be said to be at present unknown. Forty gallons of the brine produce a bushel of salt, weighing 60 pounds. These are the most productive salt wells in the world in so small a territory—two miles long and one-fourth of a mile wide.

29. Skaneateles. From the Junction with the N.Y. C. & H. R. R. the Skaneateles railroad runs south up the outlet of the lake of that name over the Corniferous limestone. The lake outlet with its falls, amounting to 463 feet to Jordan, affording excellent mill sites and many exposures of the rock. Before reaching Skaneateles Village the railroad passes over the Marcellus shales. Skaneateles Lake, where the railroad terminates, is 14 miles long, from a half to a mile and a half wide; its greatest depth south of Borodino is 330 feet and its surface 879 feet above tide. The sides of the northern end of this lake, at the beautiful village of Skaneateles, gradually slope to the water, corresponding in inclination to each other, and adding greatly to the beauty of the lake. The water line, with the exception of the south part, is excavated in the Hamilton group. The south part of the lake is more narrow, and the banks rise abruptly to a considerable height above the water. The Tully limestone, at the top of the Hamilton, and over that the Genesee slate, appear to the south of Borodino, rising, when first seen, 150 feet above the lake, and the south end or head of the lake is surrounded by the Portage group.

30. Auburn. The Corniferous member of the 9. Upper Helderberg limestone and the Onondaga limestone, which is its lower member, are extensively quarried at Auburn. The State Prison and the facings of many of the buildings of this handsome little city are entirely made of this limestone, and several fine churches are built of it. The formation ends at the main street where the 10 a. Marcellus shale begins, and it extends in the stream up to the outlet of the lake. Beginning below the city and following up the stream to the State Prison, the outlet exposes the following section: eight feet of the upper part of 6. the Waterlime of the Salina formation, one foot of 8. Oriskany sandstone, over eight feet of 9 c. Onondaga limestone and twenty-seven feet of the Corniferous exclusive of its upper member the Seneca limestone.

31. Geneva. The Seneca limestone or upper part of the 9. Upper Helderberg disappears near Waterloo and reappears at a distance of six or seven miles west near Oaks Corners. The whole mass of limestone, and all the rocks north of it to Lake Ontario, have been removed from all the intermediate space, and along the shore of that lake the great depth of alluvium conceals the rock if any be present. Near Oaks Corners the limestone suddenly terminates as if broken off and removed, leaving an abrupt descent to the east which bears evidence of the erosive action of water. Seneca Lake and Lake Ontario probably originally communicated by this deep old channel. Ontario is 196 feet lower than Seneca. The same state of things seems to exist north of Cayuga Lake, where the drift material causes the Montezuma marshes and the shallowness of that lake at that end. Seneca Lake is 40 miles long, 3 miles wide, 530 feet deep, and its surface is 441 feet above tide water.

32. Jordan. Between Skaneateles Junction and Elbridge the Oriskany sandstone is over 30 feet thick, being at its maximum. At Auburn it is from six inches to two and a half feet thick.

33. Weedsport. At many points between Syracuse and Rochester, and on the Southern Central and other cross roads, are seen numerous hills or short ridges running from north to south, from fifty to one hundred feet high, with steep slopes and very sharp crests. These are not of drift or alluvium, as they appear to be, but are in reality outliers of the marly deposits of the Salina or Onondaga salt group, with only a thin covering of loose materials. Mount Hope at Rochester, the hills south of Brighton, Fort Hill Cemetery in Auburn, James street hill and University hill in Syracuse, and numerous hog-back ridges about Jordan and other places, are of this character, being Salina shales in place, spared when the adjoining valleys were eroded. There are, however, some hills composed of gravel, or a mixture of gravel and sand, but very little glacial drift on this R. R.

34. Great crops of peppermint are raised here, and this place supplies the world with peppermint oil. There seems to be some peculiarity in the soil which adapts it for the production of this plant.

New York Central & Hudson River Rail- road—Continued. Direct Road.			New York Central & Hudson River Rail- road. Niagara Falls Division—Continued.		
Ms.			Ms.		
289	Syracuse. ²⁷	{ 6. Salina or Onondaga	426	Lockport. ²⁸	5 c. Niagara, 10 miles.
299	Warner's.	{ Salt group, 71 m. ²⁹⁵	430	Lockport Junc.	" "
302	Memphis.	" "	436	Hall's.	6. Salina, 12 miles.
307	Jordan. ²⁹	" "	441	Tonawanda.	" "
311	Weedsport. ²⁸	" "	448	Black Rock. ⁴⁰	9 c. Corniferous l.s. 4 m
314	Port Byron.	" "	449	Intern'l Bridge.	" "
324	Savannah. ^{1 & 78}	" Marshes.	452	Buffalo. ⁴⁰	" 576
328	Clyde.	" "	Direct Route.		
335	Lyons.	" "	370	Rochester. ²⁶	5 c. Niagara, 15 miles.
340	Newark.	" "	377	Coldwater.	" 488
348	Palmyra. ²⁴	" "	381	Chili.	" "
353	Macedon.	" "	385	Churchville.	6. Salina, 17 miles. 562
360	Fairport.	" "	388	Bergen.	" 602
366	Brighton. ²⁵	5 c. Niagara l.s., 10 ms.	391	West Bergen.	" "
370	Rochester. ²⁶	" "	395	Byron.	" 487
Niagara Falls Division.			402	Batavia. ⁴¹	9 c. Cornifer's, 3 m. 587
370	Rochester. ²⁶	5 c. Niagara, 10 miles.	408	Crofts.	10 b. Hamilton, 13 ms.
380	Spencerport.	5 b. Clinton, 12 miles.	414	Corfu.	" 555
383	Adams Basin.	{ Railroad runs be- tween Clinton and Medina.	418	Crittenden.	" 9 c. Cornif. 540
389	Brockport.	" "	421	Wende.	9 c. Corniferous. 20 ms.
392	Holley.	" "	423	Town Line.	" "
396	Murray.	5 a. Medina, 23 miles.	428	Lancaster.	" "
401	Albion.	" "	438	Buffalo. ⁴⁰	" 576
407	Knowlesville.	" "	Buffalo and Niagara Falls Division.		
411	Medina. ²⁷	" "	0	Buffalo.	9 c. Cornif. l.s. 5 m. 576
415	Middleport.	5 b. Clinton, 4 miles.	3	Intern'l Bridge.	" "
420	Gasport.	" "	5	Black Rock. ⁴⁰	" "
426	Lockport. ²⁸	5 c. Niagara, 21 ms. 587	11	Tonawanda.	6. Salina, 15 miles.
437	Sanborn.	" "	17	La Salle.	" "
446	Suspens. Bridge.	" "	22	Niagara Falls. ²⁹	5 c. Niagara, 4 miles.
447	Niagara Falls. ²⁹	" "	24	Suspen. Bridge.	" "
			30	Lewiston. ⁴²	{ 5 b. Clinton and 5 a. Medina. Lake, 245.

35. Irondequoit. A few miles east of the mouth of the Genesee River, the Irondequoit Creek empties into the lake, flowing in a deeper channel than the Genesee, but through deposits of sand and gravel. Professor Hall suggests with much probability, that the Genesee run in the channel of the Irondequoit, but when that was filled with gravel and the region elevated, the Genesee was turned westward and compelled to cut its present rocky bed like the Niagara. This phenomenon is not rare, but is many times repeated in this State. See notes 31, 33, 39 and 110.

36. Rochester. See Genesee Falls out of the car windows on north side at the east end of the station house. The gulf of the Genesee River, from Rochester to Charlotte, is remarkable for the striking example of erosion which it exhibits. The distance is seven miles, in which the river forms three cataracts over three distinct formations, the Medina sandstone the lowest, 84 feet fall; the Clinton 25 feet, one and three-fourth miles below, and the Niagara group 96 feet fall, close to the railroad bridge. It is evidently the different hardness of the groups or their varying facility of decomposition that have produced these falls. These three falls at first were but one, and at this time the lower ones are gaining probably on the upper one and the time may come when they will unite again.

37. The 5 a. Medina formation is named after this place.

38. At Lockport is a repetition of the Rochester and Niagara Falls ravine in the Niagara limestone and shales here crossed by the railroad on a high bridge. Here too, a mile west of the city, you can see on the north side of the railroad an old, dry channel from which the stream was diverted by the drift, corresponding to the Irondequoit at Rochester and St. David's at Niagara Falls. There is another of these dry, old channels at Oak Orchard.

39. Niagara Falls are six and a half miles south from lake Ontario at Lewiston, and the whole distance the river runs in a gulf, which, at the falls, is 160 feet, and at Lewiston 300 feet deep and generally about twice as wide at the top as at the bottom. The rocks passed through by the receding falls are the Medina sandstone, the Clinton group of limestone and shale, and the Niagara limestone and shale. These rocks have a slight southerly dip, and all except the Niagara group have disappeared beneath the bed of the river, the falls being now in the Niagara group entirely, the shale lying beneath the limestone. At the whirlpool, a little more than three miles below the falls, on the west bank of the river, the continuity of the rock forming the bank is interrupted by a deep ravine filled with drift material. This ravine may be traced two miles in a northwest direction, and from thence another depression can be followed to Lake Ontario at St. David's four miles west of Queenstown. When the ravine to St. David's was blocked up by drift materials the stream would be forced to

New York Central & Hudson River Railroad—Continued.
Ms. | Canandaigua and Tonawanda Division.

0 Canandaigua.	10 b. Hamil'n, 16 m. 778
8 East Bloomfield.	"
12 Miller's Corners.	"
15 West Bloomfield	"
18 Honeoye Falls.	9 e. Corniferous, 2 ms.
25 West Rush.	6. Salina, 22 miles.
26 Erie R. R. Junc.	"
28 Maxwell's.	"
33 Caledonia	"
40 Le Roy.	9 c. Cornif's, 25 m. 864
44 Stafford.	"
50 Batavia. ⁴¹	10 b. Hamilton. 887
57 East Pembroke.	9 c. Corniferous.
63 Richville.	"
65 Falkirk.	"
67 Akron.	"
74 Clarence Centre.	6. Salina, 21 miles.
77 Transit.	"
80 Getzville.	"
86 Tonawanda.	"

New York Central & Hudson River Railroad—Continued.
Charlotte Branch.

370 Rochester. ⁸⁶	{ 5 c. Niagara. 488
	{ 5 b. Clinton.
379 Charlotte. ⁸⁵	5 a. Medina, (Lake, 245)

Skaneateles Railroad.⁸⁹

Syracuse.	(As before.) 896
0 Skaneateles Jun	9 c. Corniferous. 610
8 Mottville.	10 a. Marcellus.
4 Kellogg's Mills.	"
5 Skaneateles. ⁸⁹	10 b. Hamilton. 890

Fonda, Johnstown & Gloversville Railroad.

0 Fonda. ¹⁸	4 b. Utica. 291
6 Johnstown.	"
8 Gloversville.	{ 4 b. Utica and
	{ 4 a. Trenton.
22 Northfield.	{ 4 b. Utica and
	{ 1 a. Laurentian.

and its present rocky channel. Even though the drift rose only a foot higher than the rocks, it would as effectually force the water over the rocks as if it formed a mountain. Could the river have once surmounted the drift, its work would have been comparatively easy in wearing out a bed through the old ravine, but till it was able to flow over the barrier it would have no power over it, and must commence its slow work of wearing away the solid rock. The present gulf shows us what it has done since the drift period.

40. At Black Rock there is only from 6 to 14 inches of the Onondaga limestone which is of a grayish color, crystalline and contains few fossils. The Corniferous limestone above it is 25 to 30 feet containing abundance of hornstone. It is dark colored, fine grained, and in its fresh fracture, and particularly when wet, it presents an almost black appearance, which has given the name of Black Rock to the place. It affords good quarries of excellent building stone. From the occurrence of the Corniferous along the south end of Lake Erie and its dip southward, it seems probable that the bed of this lake has never been excavated below it, and that it now forms the floor beneath the deposit of alluvium. It seems that there are others of the lake bottoms composed of limestone, especially Lake Ontario. See note 71. This is probably for the reason that it received a polish from the action of glaciers which then passed over it, while the resistance of the grit of the sandstones and shales was more favorable for deeper excavation. Lake Erie is 230 miles long, 50 miles wide, 140 feet deep, and its surface is 569 feet above tide.

41. Batavia is the highest point on the N. Y. C. & H. R. R. R., and one of the highest in Western New York, being 887 feet above tide. This is caused by there crossing the 9 c. Helderberg formation, which maintains its elevation although not observable as a mountain range, being overcome by easy grades. Notice the elevations of the railroad crossings of the Helderberg and Hamilton range, although the railroad seeks the lowest points: Buffalo, 576; Batavia, 887; Le Roy, 864; Canandaigua, 778; Auburn, 715; Skaneateles, 890; Tully, 1249; Cazenovia, 1249; Cooperstown, 1193. When the valleys cut through the limestone, the summit is farther south on the Hamilton or Portage.

42. Lewiston. Tourists should not fail to go down to Lewiston, the terminus of the Buffalo and Niagara Falls division. This railroad ride, although little known, is one of the finest in the United States. It follows the bank of the Niagara River, affording admirable views of the rapids and the formations displayed in the gulf. Nowhere in the State are there better geological sections. On the Canada side, also the Canada Southern Railway, running to the mouth of the Niagara River at Niagara City, affords one good view of the falls, but no such remarkable sections of the rocks as on the American side, where the railroad overhangs the fearful torrent of the river for several miles.

43. Knowersville. The Helderberg mountain shows finely on the left or southwest side of the railroad opposite Guilderland and Knowersville. The railroad passes through it between that place and Duaneburgh. The mountain is capped by the 7. Lower Helderberg limestone forming a steep precipice along its summit, and this rests on the 4 c. Hudson River slates. Back of Knowersville two notches are cut out of the mountain by two streams, leaving a picturesque, fortress-like bluff of the limestone. The Helderberg formations are named from this mountain.

44. At Howe's Cave large quarries on the railroad track. Good place to examine Lower Helderberg limestone and to collect fossils. The cave is an old underground water channel, and is several miles long. Notice that the limestone at Cobleskill is *Upper* Helderberg and that at Howe's Cave *Lower* Helderberg. On no other railroad can you see them both.

45. Cooperstown is seated at the south end of Otsego Lake on a dike of alluvium. This lake is a handsome sheet of water seven miles long, one and a half wide, 1193 feet above the ocean. It has a high ridge of the Hamilton group on the east side, a low and interrupted range of the same on the west side, and an elevated projection on the northeast end. This lake is one of the head waters of the Susquehanna, the valley spreading out to the southwest.

46. Sharon Springs. All the large sulphur springs of the State, Avon, Clifton, Richfield, &c., and many small ones, rise from the waterlime.

47. Cherry Valley. The railroad is on Corniferous, but the cliffs and gorge are 7. Lower Helderberg. Marcellus and Hamilton form the hills on the south.

Delaware & Hudson Canal Co.'s Railroads.			Delaware and Hudson Canal Company's Railroads—Continued.		
Ms.	Albany and Susquehanna Railroad.		Ms.	Middleburg & Schoharie, and Schoharie Valley Railroads.	
0 Albany. ¹⁰	4 c. Hudson River.		Central Bridge ¹	} 4 c. Hudson River.	
6 Adamsville.	"		0 or Schoharie		
7 Slingerlands.	"		Junction.		
11 New Scotland.	"		3 Vromans. ⁴⁸	"	
14 Guilderland.	"		6 Schoh'e C. H. ⁴⁹	9 b. Schoharie grit.	
17 Knowersville. ⁴⁸	"		9 Borst's.	7. Lower Helderberg.	
24 Duaneburg.	" & Utica.		12 Middleburg.	10 a. Marcellus.	
27 Quaker Street.	"		Nineveh Branch.		
31 Esperance.	"		119 Nineveh.	11 b. Chemung.	
36 Central Bridge.	7. L. Helderberg.		122 Centre Village.	"	
39 Howe's Cave. ⁴⁴	"		127 Ouaquaga.	"	
45 Cobleskill.	8. Oriskany.	Portage hills.	130 Windsor.	"	
	9 c. U. Helderberg l.s.		133 Comstock.	"	
	10 a. Marcellus.		140 Jefferson Junc.	"	
50 Richmondville.	" & 10 b. Ham.		Saratoga and Champlain Division.		
57 East Worcester.	10 b. Hamilton.		0 Albany. ¹⁰	4 c. Hudson River.	
62 Worcester.	"		6 West Troy.	"	
67 Schenevus.	11 a. Portage.		9 Cohoes. ⁵⁰	" Falls, 70 ft.	
70 Maryland.	"		12 Albany Junc.	"	
75 { Cooperstown	"		0 Troy.	"	
75 { Junction. ⁴⁵	"		6 Albany Junc.	"	
76 Colliers.	11 b. Chemung.		12 Mechanicsville.	"	
79 Emmons.	"		25 Ballston.	"	
82 Oneonta.	"		32 Saratoga.	4 a. Trenton and Calcif.	
90 Otego.	"		43 Gansevoorts.	"	
93 Wells Bridge.	"		49 Fort Edward.	"	
99 Unadilla.	"		57 Smith's Basin.	" quarries.	
103 Sidney.	12. Catskill, synclinal.		60 Fort Ann.	"	
108 Bainbridge.	"		64 Comstock's.	{ 2 b. Potsdam. Fine surface exposures for 4 miles.	
114 Afton.	11 b. Chemung.		71 White Hall.	{ 2 b. Potsdam. Fine exposures on 1 a. Laurentian gneiss.	
119 Nineveh.	"		0 White Hall. ⁵¹	" Lake, 96.	
127 Tunnel.	"		3 a. Calciferous.	{ " & 1 a. Laur. back.	
132 Osborn Hollow.	"		7 Chubb's Dock.	1 a. Laurentian.	
135 Port Crane.	"		10 Dresden. ⁵²	"	
142 Binghamton.	"	888	14 Putnam.	3 a. Calciferous bluff.	
Saratoga.	{ 3 a. Calciferous and		20 Pattuiwa.	4 a. Trenton. Valley.	
0 Ballston.	{ 4 a. Trenton.		(Mt. Defiance.)	1 a. Laurentian.	
15 Schenectady.	4 c. Hudson River.	287	22 Ft. Ticonderoga.	"	
29 Quaker Street.	"		(Ticon'ga Creek, outlet of Lake George.)	4 a. Trenton.	
45 Cobleskill.	9 c. Upper Helderberg.		(Tunnel.)	" large valley.	
50 Hyndsville.	"		24 Addison Junc.		
54 Seward.	"				
59 Sharon Sprgs. ⁴⁶	7. Lower Helderberg.				
68 Cherry Valley ⁴⁷	9 c. Cornif. & Marcellus.				
Cooperstown and Susquehanna Valley R.R.					
75 Junction.	11 a. Portage.				
91 Cooperstown ⁴⁵	10 b. Hamilton.	1198			

48. On either side of the valley, according to Prof. Hall, is the following section: Pyritiferous shales (Clinton group); Coralline limestone (Niagara); Waterlime (Salina); Tentaculite; Pentamerus; Delthyris shaly limestone; Upper Pentamerus (Lower Helderberg); Oriskany; Canda Galli; Schoharie grit; Onondaga limestone (Upper Helderberg). At Vromans are cliffs of Hamilton, "Vroman's Nose."

49. The Schoharie grit formation was named from this place. The fossils peculiar to it are found in the mountain one and a half miles northwest and northeast of Schoharie.

50. See from car windows the great falls of Mohawk, 70 feet high, over Hudson River slate.

51. Whitehall is usually called the head of Lake Champlain, but the lake for 15 miles is rarely more than 100 to 150 yards wide. It is in fact a mere channel between mud flats and clayey alluvium. Lake Champlain is 112 miles long, 600 feet deep, and the surface being only 96 feet above tide, it

Delaware and Hudson Canal Company's Railroads.			Delaware and Hudson Canal Company's Railroads—Continued.		
Ms. Saratoga and Champlain Division—Cont.			Ms. Ausable Branch.		
		1 a. Laurentian bluff	0 Plattsburg.	2 b. Potsdam.	
		4 a. Trenton.	5 Salmon River.	3 a. Calciferous.	
32	Crown Point.	1 a. Laurentian bluff.	8 Lapham's Mills.	1 a. Laurentian.	
		4 a. Trenton, 7 miles.	10 Peru.	"	
		Valley chiefly 1 a. Laur.	14 Harkness.	"	
40	Port Henry. ⁵³	1 a. Laurentian.	17 Ferronia.	"	
	(Tunnel.)	"	20 Ausable. ⁵⁷	"	
51	Westport. ⁵⁴	"	Glens Falls Branch.		
54	Wadham's Mills	"	49 Fort Edward.	4 a. Trenton.	
57	Whallonsburgh. ⁵⁵	{ For 13 miles deep cuts through bluffs, 1 a. Laurentian. Beautiful sections.	53 Sandy Hill.	"	
64	Wilsborough ⁵⁵		55 Glens Falls.	"	" Utica slate above.
77	Port Kent. ⁵⁶	1 a. Laurentian ends.	Lake George Branch.		
	(Ausable R.) ⁵⁷	2 b. Potsdam.	22 Ticonderoga.	1 a. Laurentian.	
84	Valcour.	{ 2 b. Potsdam. Heavy	26 Baldwin on Lake	{	"
90	Plattsburg. ⁵⁷	beds of sand & clay.	George. ⁵⁹		
95	Beekmantown.	{ 4 a. Trenton and	Adirondack Railroad.		
99	West Chazy.	{ 3 c. Chazy.	0 Saratoga.	4 a. Trenton & 3 a. Cal.	
100	Chazy. ⁵⁸	"	6 Greenfield.	2 b. Potsdam.	
105	Sciota.	"	10 King's. ⁶⁰	"	
111	Moorer's Junc.	"	13 South Corinth.	"	
118	Champlain.	"	17 Jessup's Land'g	"	
		{ 3 a. Calciferous &	22 Hadley. ⁶⁰	1 a. Laurentian.	
		{ 3 c. Chazy.	30 Stony Creek.	"	
99	West Chazy.	"	36 Thurman.	"	
122	Rouse's Point.	"	44 The Glen.	"	
	(Con. in Canada, see Grand Trk. R'y.)	No rock exposures.	47 Washburn's Eddy.	"	
			50 Riverside.	"	
			58 North Creek.	"	

extends 500 feet below the level of the ocean. Its bed is a deep chasm in the Laurentian or Primitive rocks. On the west side, where the mountain ranges reach it, the slope is abrupt, but on the east side it is longer and more gradual. At many places the lake is bordered by steep banks of blue and yellowish brown clay and yellowish brown sand, rarely over 15 feet thick, but its greatest height is 100 feet at Burlington. It contains marine fossils in the mixture of clay and sand, but none in the clay beneath. This drift formation extends north to the mouth of the St. Lawrence River. In Albany County it is an immense mass and is known as the Albany clay.

52. From Dresden to Port Kent, 67 miles, the Laurentian hills are the western boundary of the valley of Lake Champlain. But at many points this mountain ridge recedes from the lake, leaving nooks and valleys, in which are patches of 3 c. Chazy and 4 a. Trenton limestone along the railroad.

53. The magnetic iron ore mines back of Port Henry are worth a visit, the bed of the ore being more than 100 feet thick. The mining of these heavy beds is on a grand scale.

54. From 51 Westport to 77 Port Kent, the formation, according to Dr. Hunt, is 1 c. Norian or Upper Laurentian.

55. At the village of Essex, on the lake and between Wallonsburg and Willsboro stations, is a bold bluff, 100 to 200 feet high above the lake, of 3 c. Chazy limestone.

56. The Adirondack Mountains commence at Little Falls, rising suddenly from the Mohawk Valley, and run northeast to Port Kent on Lake Champlain. The most elevated peak, Mount Marcy, is 5,467 feet high, the summit being just upon the region of perpetual frost. There are four other peaks 5,000 feet high, each distant about 6 miles from the other. This group of Adirondack Mountains is the culminating point of the State around the sources of the Hudson, Ausable, Racket and Black Rivers, and dividing the north half of the State into two separate geological basins. They are directly west of Westport, several miles to the west of the railroad. Only a glimpse of one of them can be had from the railroad. In the Adirondack pass in Essex County, is a perpendicular precipice or naked wall of rock 1,000 feet high and more than half a mile long. There is not probably in the Eastern States an object of the kind so vast and imposing as this. Emmons, 218.

57. Stop at Plattsburg and visit the Ausable valley, which is interesting for the Ausable chasm, where for at least two miles the Ausable River, a large and rapid stream, is compelled to flow through a rocky gorge in the 2 b. Potsdam sandstone with perpendicular walls of 100 feet with a width only varying from 20 to 40 feet. Here the *Angula antiqua* is found in great abundance, and there is here a better development of the Lower Silurian or Cambrian rocks than in any other part of the State. Emmons, 267.

58. The 3 c. Chazy formation was named from this locality. See Note 55. Also as to Isle La Motte see Note 67.

59. The rock which forms Diamond Island in Lake George is a good example of 3 a. Calciferous. Lake George is 30 miles long, 1½ miles wide, and its surface is about 80 feet above tide water.

Central Vermont Railroad.			Ms. Utica and Black River Railroad— <i>Con.</i>		
Ms. Ogdensburg & Lake Champlain Railroad.			25 East Steuben.		
0 Ogdensburg.	3 a. Calciferous, 20 ms.		28 Alder Creek.	4 a. Trenton.	
9 Lisbon.	"		35 Boonville. ⁶³	"	1120
17 Madrid.	"		38 Leyden.	"	
25 Norwood.	"		42 Port Leyden.	"	
28 Knapps.	2 b. Potsdam, 53 miles.		45 Lyons Falls. ⁶⁴	1 a. Laurentian, 1 mile.	
36 Brasher Falls.	"		51 Glendale.	4 a. Trenton, 28 miles.	
41 Lawrence.	"		54 Martinsburg. ⁶⁵	"	
47 Moira.	"		58 Lowville.	"	
55 Bangor.	"		66 Castor Land.	"	
61 Malone.	"		70 Deer River.	"	
73 Chateaugay.	1 a. Laurentian, 5 ms.		74 Carthage. ⁶⁶	1 a. Laurentian.	
81 Cherubusco.	2 b. Potsdam, 36 miles.		81 Great Bend.	4 a. Trenton, 18 miles.	
89 Ellenburgh.	"		83 Felt's Mills.	"	
90 Dannemora.	"		85 Black River.	"	827 [River.
97 Altona.	"		92 Watertown. ⁶⁷	Tren., Birdseye & Black	
103 Mooer's Forks.	"		104 Sacket's Harbor	"	
106 Mooer's Junc'n.	3 c. Chazy.		74 Carthage. ⁶⁶	1 a. Laure'n, 6 ms. ⁷²¹	
114 Champlain.	3 a. Cal. & 3 c. Chazy, 4		92 Theresa Junc.	2 b. Potsdam.	
118 Rouse's Point.	3 c. Chazy, 2 ms. [ms		98 Orleans Corners	3 a. Calciferous.	
122 Alburgh.	4 b. Utica, 13 miles.		101 Lafargeville.	"	
126 Alburgh Springs	"		108 Clayton.	2 b. Potsdam.	
133 Swanton.	4 c. Hudson River.		74 Carthage. ⁶⁶	1 a. Laurentian, 1 mile.	
136 Swanton Junc.	"		83 Sterlingsville.	3 a. Calciferous, 1 mile.	
142 St. Albans, Vt.	2 b. Potsdam, 6 miles.		87 Philadelphia.	2 b. Potsdam, 8 miles.	
Utica and Black River Railroad.			90 Shurtliff's.	"	Iron ore.
0 Utica.	4 b. Utica, 12 miles. ⁶⁸		98 Theresa Junc'n.	"	
6 Marcy.	"		95 Theresa.	{ 1 a. Laurentian and	
10 Stittville.	"			{ 2 b. Potsdam, 18 ms.	
12 Holland Patent.	4 a. Trenton, 32 miles.		101 Redwood.	"	
16 Trenton.	"		108 Rossie.	"	Lead mine.
18 Trenton Falls. ⁶²	"		113 Hammond.	2 b. Potsdam, 10 miles.	
19 Prospect. ⁶²	"		118 Brier Hill.	"	
21 Remsen.	"		123 Morristown.	"	& 1 a. Laur'n.

60. This railroad cuts through Trenton, Calciferous and Potsdam within less than 10 miles of Saratoga. Fine sections of ripple marked Potsdam in railroad cut in Greenfield. The Ausable chasm is repeated at the High Falls of the Hudson at Luzerne or Hadley station on the Adirondack Railroad, in Warren County, where the river flows for a mile through a gorge at the junction of the Potsdam sandstone and the gneiss. The walls rise in some places to a height of one hundred feet.

61. Potsdam. This is the locality which gave the name to the Potsdam sandstone. See the description of that formation in another part of this volume.

62. Trenton Falls. For about three miles between Trenton Falls station and Prospect, station and a mile or two east of the railroad, the East Canada Creek has cut a passage through the Trenton limestone, the sides of the excavation rising vertically with an average height of over 100 feet. In this passage are the Trenton Falls or Cascades which have given so much celebrity to the place, justly meriting by their number, beauty and position, the admiration they receive. Including the one at Prospect Village there are six falls, five of which are placed at intervals somewhat regular and occupy the middle part of the excavation. The rock is in thin layers of from 6 to 10 inches in thickness, separated by thin layers of shale, and contains trilobites in prodigious numbers. The formation derives its name from this place. It is 500 feet thick and about seven miles in breadth. Going east or south it grows thinner and is about 80 feet thick in the Mohawk Valley. The stone quarried at Prospect and used at Utica, is the upper part of the Trenton, which is here of a gray color and of a more solid and crystalline structure and appearance. Going on north by this railroad you travel for many miles on a terrace of the limestones of this group, forming the banks of Black River, which has its rocky channel in this formation all the way to Watertown, with three important falls at Lyons, Carthage and Watertown and many cascades. Very picturesque scenery and interesting geology, with an abundance of fossils.

63. Boonville. The first range or cliff of limestone on Black River, extending by the side of the river from opposite Boonville to Watertown, is the Birdseye limestone. It is of a light dove color which by long exposure to the weather becomes of a light ash gray or white. It is in thick, straight layers, with straight, vertical joints, giving the rock when quarried the appearance of a wall, and it has a compact grain and smooth fracture.

64. At Lyons Falls, Black river falls 63½ feet over gneiss or 1 a. Laurentian rock. Thence to Carthage it falls but 9 feet and there is another fall over gneiss rock.

65. The high hills west of Martinsburg are of the Hudson River group.

Rome, Watertown and Ogdensburg Railroad.			Rome, Watertown & Ogdensburg R.R.—Con.		
Ms.			Ms.	Syracuse Division.	
0 Rome.	4 c. Hudson River. ⁴⁸⁹		0 Syracuse. ²⁷		{ 6. Salina or Onondaga Salt group. ⁸⁹⁶
11 Taberg.	" 11 miles.		5 Liverpool.		" "
14 McConnellsville	{ 5 a. Medina and Oneida Conglomerate, 31 miles.		8 Woodward.	5 c. Niagara.	
18 Camden.	"		11 Clay.	5 b. Clinton.	
23 West Camden.	"		15 Brewerton. ¹⁰⁸	"	
28 Williamstown.	"		18 Central Square.	5 a. Medina.	
31 Kasoag.	" ⁸⁸⁶		22 Mallory.	"	
37 Albion.	"		24 Hastings.	"	
42 Richland. ⁸⁸	"		27 Parish.	"	
47 Sandy Creek.	4 c. Hudson River, 12 m.		31 Union Square.	4 c. Hudson River.	
52 Mannsville.	" Lora.shales,		34 Holmesville.	"	
54 Pierrep't Manor.	" deep gulfs,		39 Pulaski. ⁷⁰	"	
59 Adams. ⁶⁹	4 a. Trenton limestone.		45 Sandy Creek Ju.	"	
63 Adams Centre.	"		Lake Ontario Division, West.		
72 Watertown Jun.	Tren., Birdseye & Black River.	⁸⁹⁷	0 Oswego. ⁷¹	5 a. Medina. Lake, 245.	
73 Watertown. ⁶⁷	"		4 Furniss.	"	
78 Sanford's Corn's	"		7 Wheeler's.	"	
83 Evans' Mills.	3 a. Calciferous.		10 Hannibal.	5 b. Clinton.	
90 Philadelphia.	2 b. Potsdam.		13 Sterling Valley.	"	
96 Antwerp.	1 a. Laure'n, Iron ore.		16 Sterling.	"	
101 Keene's.	"		20 Red Creek.	"	
108 Gouverneur.	2 b. Potsdam.		26 Wolcott.	" Fossil iron ore.	
115 Richville.	1 a. Laurentian.		31 Rose.	"	
123 De Kalb Junc'n	" Iron ore.		36 Alton.	"	
129 Rensselaer Falls	2 b. Potsdam.		38 Wallington.	"	
134 Heuvelton.	"		41 Sodus.	"	
142 Ogdensburg.	3 a. Calciferous.		47 Williamson.	"	
42 Richland. ⁶⁸	5 a. Medina.		52 Ontario.	" Fossil iron ore.	
47 Pulaski. ⁷⁰	4 c. Hudson River.		56 Union Hill.	" "	
50 Sandhill.	5 a. Medina.		59 Webster.	"	
55 Mexico.	"		64 Pierce's.	"	
60 New Haven.	"		66 Sea Breeze. ⁸⁵	5 a. Medina.	
63 Scriba.	"		70 Charlotte. ⁸⁵	"	
71 Oswego. ⁷¹	" Lake, 245		76 Greece.	"	
73 Watertown. ⁶⁷	4 a. Trenton. ⁸⁹⁷		80 North Parma.	"	
72 Watertown Jun.	"		83 East Hamlin.	"	
76 Brownville. ⁷²	"		86 Hamlin.	"	
86 Chaumont.	"		90 East Kendall.	"	
89 Three-Mile Bay.	"		92 Kendall.	"	
93 Rosiere.	"		97 East Carlton.	"	
97 Cape Vincent.	" ⁸⁵⁰		100 Carlton.	"	
123 De Kalb Junc'n.	1 a. Laurentian.		108 Waterport.	"	
131 Canton.	2 b. Potsdam.		106 Carlyon.	"	
142 Potsdam. ⁸¹	"		110 Lyndonville.	"	
148 Potsdam Junc'n	3 a. Calciferous.		114 County Line.	"	
			118 Somerset.	"	
			123 Hess Road.	"	
			127 Newfane.	"	
			128 Coomer Road.	"	
			132 Wilson.	"	
			147 Rawsonville.	"	
			156 Lewiston. ⁴⁸	" Lake, 245.	

66. The Laurentian rocks cover the whole of the country east of the Black River and the later formations west of the river, the opposite sides forming the strongest contrast imaginable as to rocks, soil, vegetation and population.

67. At Watertown the banks of the Black River present fine sections of the limestone visible from the car windows, showing the Trenton limestone, Black River limestone and the Birdseye limestone. There is a mass forming the Black River sub-division, known to quarrymen as the seven feet tier, lying between the Birdseye and Trenton limestone. At the Isle LaMotte, near Chazy, in Lake Champlain, it is a black marble, but at Watertown it is only suitable for ordinary purposes.

Delaware, Lackawanna and Western Railroad.			Delaware, Lackawanna and Western Railroad—Continued.		
Ms.			Ms.		
0 Binghamton.	11 b. Chemung.	888	60 Poolville.	10 b. Hamilton.	Few exposures of rock on the railroad.
7 Chenango.	"		64 Hubbardsville.	"	
11 Chenango Forks	"		68 Nor. Brookfield.	"	
21 Whitney's Point	"		72 Sangerfield Cen.	"	
23 Lisle.	"		73 Waterville.	"	
30 Marathon.	"		78 Paris.	9 c. Corniferous.	
35 State Bridge.	"		81 Richfield Junc.	6. Salina.	
44 Cortland.	11 a. Portage.	1111	84 Clayville.	5 b. Clinton.	
47 Homer.	"		86 Sauquoit.	"	
54 Preble.	10 a. Genesee.		87 Chadwick's.	"	
59 Tully. ⁷⁸	10 b. Hamilton.	1849	89 Washing'n Mills	"	
61 Apulia.	"	1821	91 New Hartford.	"	
66 Onativia.	10 c. Marcellus.		95 Utica. ¹⁸	4 b. Utica.	408
73 Jamesville. ⁷⁴	9 c. Corniferous.	585	81 Richfield Junc'n	6. Salina.	Few exposures of rock on the railroad.
80 Syracuse. ⁸⁷	6. Salina.	895	85 Bridgewater.	10 b. Hamilton.	
80 Syracuse. ⁸⁷	6. Salina.	895	86 Unadilla Forks.	11 b. Chemung.	
92 Baldwinsville.	5 c. Niagara.		88 West Winfield.	12. Catskill, synclinal.	
98 Lamson's.	5 b. Clinton.		90 Cedarville.	10 b. Hamilton.	
104 Fulton. ⁷⁵	5 a. Medina.		92 Miller's Mills.	"	
115 Oswego. ⁷¹	"	Lake, 245.	99 South Columbia.	"	
			102 Richfield Spgs. ⁴⁶	9 c. Upper Helderberg.	
Cayuga Division.			0 Utica. ¹⁸	4 b. Utica.	408
0 Owego.	11 b. Chemung.	888	4 New Hartford.	5 b. Clinton.	
4 Cattatunk.	"		9 Clinton. ⁷⁶	"	
10 Candor.	"		11 Franklin I. W.	5 c. Niagara.	
14 Wilseyville.	11 a. Portage.	918	14 Deansville.	6. Salina.	
33 Ithaca on the hill.	"	945	18 Oriskany Falls. ⁸⁰	8. Oriskany s.s. on 7. L.	
33 Ithaca on the Lake.	"	876	21 Solsville.	10 b. Hamilton.	[H'g.
0 Binghamton.	11 b. Chemung.	888	24 Bouckville.	"	
11 Chenango Forks	"		26 Peaksport.	"	
19 Greene.	"		29 Hamilton.	"	
25 Brisbin.	"		31 Smith's Valley.	"	
29 Coventry.	"		0 Clinton. ⁷⁶	5 b. Clinton.	
33 Oxford.	10 a. Portage.	956	2 Kirkland.	"	
41 Norwich.	10 b. Hamilton.	1000	3 Clark's Mills.	"	
47 North Norwich.	"		5 Westmoreland.	"	
52 Sherburne.	"	1048	7 Bartlett.	"	
57 Earlville. ⁷⁴	"	1077	13 Rome.	4 c. Hudson River.	489

The Falls of Black River in Watertown are 35 feet perpendicular over the limestones at the Suspension Bridge, and 112 feet within the city limits in six separate falls.

68. There are two miles of rapids in Salmon River, which terminate in a fall of 107 feet. At high water the sheet of water is 250 feet wide, and at low water about half that extent. The fall is over the grey sandstone of the 5 a. Medina, and is seven miles northeast from Richland.

69. Adams. The Gulf of Loraine, on South Sandy Creek, is a genuine canon upon a small stream flowing through the Loraine or Hudson River slates, Utica slate and Trenton limestone in the town of Loraine, from which some geologists prefer that name for the formation. The walls are perpendicular and vary in height from 100 to 300 feet, and the gulf varies in width up to 16 rods. There are several of these gulfs in Jefferson County, some of them 12 miles in length, reaching to the starting points of the streams. A convenient place to stop to study the Loraine shales, a huge mass of mud rock, is the pleasant village of Adams. There are two of these gulfs within two miles southeast in the town of Loraine, but not on the stream in the village, which is on Trenton limestone. On the way observe a remarkable moraine of naked Laurentian boulders, some of them very large. This ridge crosses the railroad just south of Adams, where are many boulders in the fields, and is said to extend from Lake Ontario south of Woodford northeast into Canada. The ridge road, which runs all along Lake Ontario, also occurs here a little nearer the lake than the ridge of boulders.

70. The shales and sandstones at Pulaski are the upper part of the 4 c. Hudson River, which were at first called Pulaski Shales, or the Shales of Salmon River, and Loraine Shales. It is the only rock at Pulaski village, and is full of fossils, while the lower or Frankfort division has very few.

71. Oswego. Lake Ontario, like all other New York lakes, is a lake of excavation. Along its northeast shore, in Canada, is the 4 a. Trenton limestone. On its south or New York shore we find the 5 a. Medina sandstone extending from Oswego, the whole length of the lake, to Hamilton in Canada. The lake is excavated 50 feet in the red and 100 feet in the gray 5 a. Medina formation, 230 feet in the Hudson River and 120 feet in the 4 b. Utica slate, the whole making a thickness of

Ms. Geneva, Ithaca and Sayre Railroad.			Ms. Cayuga Southern. 77		
0 Sayre. ¹⁰⁹	11 b. Chemung.	774	0 Cayuga. ⁷⁸	6. Salina. Lake, 376.	
2 West Waverly.	"		6 Union Springs. ⁷⁹	{ 6. Salina, with Gyp- sum beds. 9 c. Cor- niferous quarries.	
9 Bingham's.	"		10 Levanna. ⁸⁰	{ 10 a. Marcellus.	
16 Van Etenville.	"		13 Aurora. ⁸¹	{ 10 b. Hamilton.	
19 Spencer.	"		16 Willett's.	"	
23 North Spencer.	"		20 King's Ferry.	" Bluffs 100 ft.	
27 West Danby.	"		22 Atwater's.	"	
31 Newfield.	"		25 Lake Ridge. ⁸²	" Tully limes.	
38 Ithaca. ⁸⁴	11 a. Portage.	876	27 Taughannock.	"	
44 Willow Creek.	"		32 Ludlowville. ⁸³	{ 10 c. Genesee and Portage.	
46 Taghanic Falls.	" Gulf.		38 Ithaca. ⁸⁴	11 b. Portage.	876
48 Trumansburg.	"		Northern Central Railroad.		
51 Covert.	" Tully limestone.		0 Elmira. ¹⁰⁸	11 b. Chemung.	863
54 Farmer.	10 b. Hamilton.		6 Horse Heads.	"	897
57 Ovid Centre.	"		10 Pine Valley.	"	891
61 Hayt's Corners.	"		13 Millport.	11 a. Portage.	
65 Romulus.	"		19 Havana. ⁸⁵	"	453
70 West Fayette.	"		22 Watkins. ⁸⁶	" Lake, ⁴⁴¹	447
77 Geneva. ⁸¹	{ 9. c. Corniferous. An ancient deep chan- nel northward, filled with gravel drift. ⁴⁵²		29 Rock Stream.	"	
Ontario Southern Railroad.			31 Big Stream.	10 c. Genesee, gulf.	
0 Sodus Point.	5 a. Medina. Lake, 246.		33 Starkey.	"	804
4 Wallington.	"		37 Himrod's.	"	798
6 Sodus Centre.	5 b. Clinton.		41 Milo.	"	881
10 Zurich.	"		45 Penn Yan. ⁸⁷	" & Portage.	780
13 Fairville.	5 c. Niagara.		49 Benton.	"	
16 Newark.	6. Salina.		51 Bellona.	10 b. Hamilton.	857
20 Marbleton.	"		55 Hall's.	"	898
22 Outlet.	"		58 Stanley.	"	
23 Phelps.	9 c. Corniferous.		61 Lewis.	"	
27 Orleans.	"		63 Hopewell.	"	844
31 Flint.	"		69 Canandaigua. ⁸⁸	Lake, 668"	734
34 Stanley.	10 b. Hamilton.	885			

500 feet or the real depth of the lake, the surface of the 4 a. Trenton limestone being its bottom. It is 180 miles long, 40 miles wide, 493 feet deep and its surface is 345 feet above tide water.

72. Midway between Watertown and Brownville the whole river falls 60 feet in less than half a mile, running in a gorge with high banks.

73. Tully. The Tully limestone, separating the Hamilton from the Genesee, which is named from this place, is not seen on the railroad, but is found further to the west. The swamp near Preble is supposed to be underlain by the Tully limestone.

74. Between Syracuse and Jamesville are good natural sections of the 6. Waterlime and 9. Onondaga and Corniferous limestones, many quarries and natural cliffs. Beyond Jamesville observe the transition into the Hamilton group where the high hills begin, the Marcellus shales being deeply excavated. Visit Green Lake, near Jamesville.

75. The red sandstone of the 5 a. Medina formation is well displayed at Fulton, in Oswego County, where it causes the Oswego Falls and forms the banks and bed of the river above and for half a mile below. The upper layers are covered with *Fucoides Harlani*, some of them of gigantic size.

76. The 5 b. Clinton formation is named from this place.

77. This is one of the best railroads in the State for geological observations. There are many points on the Cayuga Railroad where the junction of the Hamilton with the Tully limestone and of the latter rock with the Genesee shale, and of the Genesee with the Portage group are perfectly seen in juxtaposition. The lake affords every evidence and facility for geological sections.

78. Cayuga Lake is 40 miles long, 34 miles wide, 390 ft. deep, and its surface is 376 ft. above tide. The gypsum beds are finely displayed just north of Union Springs, and large quantities are produced for market. South of the town the 9. Upper Helderberg range crosses, and causes an inlet in the lake. Its lower layers, the Onondaga limestone, make beautiful quarries.

80. The low clayey land extending nearly to Levanna is on the 10 a. Marcellus shale. The first rock south of this is the dividing line between the Marcellus and Hamilton.

81. The 10 b. Hamilton presents its first bluff south of Aurora, 30 to 50 feet high, containing numerous fossils. Further south are many others, some of them 100 feet high, extending for miles. Nothing could be finer than these geological sections of the Hamilton.

82. The Tully limestone first appears at Lake Ridge, from which the station is named. It is the dividing line between the 10 b. Hamilton and the 10 c. Genesee. It dips as you go south and rises again. This looks like a flexure of the formations, but it is caused by the change in the course of

Ms. | Syracuse, Geneva & Corning Railroad.

0 Geneva. ⁸¹	9 c. Corniferous.	453
9 Earle. ⁸⁹	10 a. Marcellus.	
	{ 522 " Tully lime-	
14 Dresden. ⁸⁷	stone, 1 mile south.	
21 Himrod's.	10. Hamilton.	854
26 Dundee.	"	968
30 Rock Stream.	11 a. Portage.	
33 Reading Centre.	"	Gulfs 1043
36 Watkins Glen.	"	1015
	{ 1021 "View of Glen.	
37 Glen Bridge. ⁸⁶	Bridge 150 feet high.	
45 Beaver Dam.	11 a. Portage.	1267
49 Post Creek.	11 b. Chemung.	1175
52 Ferrenburg.	"	
58 Corning.	"	943

Corning, Cowanesque & Antrim Railroad.

0 Corning.	11 b. Chemung.	943
15 Lawrenceville, Penn.	"	
22 Tioga Village.	"	1008
39 Wellsboro.	"	1380
51 Antrim.	{ 14 b. Semi-bituminous	
	Coal Measures.	1673
15 Lawrenceville.	11 b. Chemung.	1008
23 Nelson.	"	
27 Elkland.	"	1143
48 Fall Brook.	"	1794

Tioga, Elmira and State Line Railroad.

0 Elmira. ¹⁰⁸	11 b. Chemung.	882
1 Erie Junction.	"	
3 State Line Junc.	"	
7 Wells.	"	
9 Seeley Creek.	"	1041
10 State Line.	"	
12 Millerton, Penn.	"	1244
15 Trowbridge.	12. Catskill.	1440
17 Summit.	"	1594
23 Tioga Junction.	11 b. Chemung.	1081
24 Mitchell's.	"	
25 Old Station.	"	
26 Tioga.	"	1043
27 Berry's Bridge.	"	
35 Mansfield.	1140 " Iron ore.	
40 Covington. ¹²⁰⁸	12. Cats'll, Fish beds. ⁹⁰	
45 Blossburg. ¹³⁴⁸	14 b. Coal Measures.	
49 Arnot.	1433 " coal mines.	
45 Morris Run.	"	1655

Ms. | Syracuse, Chenango and N. Y. R. R.

0 Syracuse. ⁴⁷	6. Salina.	595
8 Manlius Cen. ⁹¹	7. L. Held., Waterlime.	
10 Fayetteville.	" & 9. Onon. l.s.	560
12 Manlius.	{ 9. Onondaga limest.	
	Heavy beds.	720
15 Oran. ⁹³	9. Onondaga l. s.	897
	{ 10 a. Marcellus.	1218
Tunnel.	10 b. Tunnel in Ham-	
	ilton sandstone.	
20 Cazenovia. ⁹³	10. Hamilton.	1190
23 Webster's.	"	
29 Erieville.	"	1596
32 Georgetown.	"	1637
38 Lebanon. ⁹⁴	{ 10 c. Genesee.	1864
	11 a. Portage, cliffs.	
45 Earlville.	10 c. Genesee.	1077

Cazenovia, Canastota & De Ruyter R.R.⁹⁶

0 Canastota.	6. Salina.	439
3 Clockville.	"	687
4 Colton.	"	
5 Oak Hill.	" Gypsum in cuts.	
6 Quarries. ⁹⁵	9. Onondaga limestone.	
8 Perryville. ⁹⁶	"	1041
9 Hyatt's.	"	
11 Chitt'go Falls. ⁹⁷	10 c. Marcellus.	
12 Bingley.	"	1041
13 Shelter Valley.	"	
14 Firndell.	10 a. Hamilton.	
15 Cazenovia. ⁹⁸	"	1177
17 Syr. & Chen. Junc.	"	1248
22 New Woodstock	"	1393
25 Shedd's Corners.	"	1386
30 De Ruyter.	10 c. Genesee.	1276

Southern Central Railroad.

0 Sayre. ¹⁰⁹	11 b. Chemung.	774
7 Barton.	"	
10 Smithboro.	"	
14 Tioga.	"	
20 Owego.	"	811
24 Flemingville.	"	
29 Newark Valley.	"	953
35 Berkshire.	"	1028
39 Richford.	"	1090
43 Harford Mills.	"	
45 Harford.	"	1179
51 Dryden.	1072 "Summit, 1215.	

the lake. After rising again it forms a beautiful coping of the Hamilton group for miles above Taughannock. See the description of the 10 b. Tully limestone.

83. This is one of the best localities of the Hamilton group which we know. South of Ludlowville the 10 c. Genesee shale appears above the Tully limestone. It is uniformly black, of a slaty structure, fine grained, a hard and brittle mud rock, its edges resisting the weather, but its surface when exposed falling into pieces. You get a good section of the base of the Portage here. There is a well marked dividing line here between the Genesee and Portage, being a sandstone 2 or 3 feet thick, very compact and solid, with its under surface filled with fucoids raised in relief, one or two inches long, with their ends depressed. The eye readily follows it as it dips toward the water.

84. Every part of the Portage group can be inspected in the ravines and water falls in the vicinity of Ithaca.

85. There is a glen here, one mile southeast from the station, quite equal to that at Watkins. It is also in the Portage. See Note 86.

86. Watkins Glen is in the 11 a. Portage. It is a great wonder and very beautiful. There is a grand view of the chasm in crossing the bridge over it at Glen Bridge on the Syracuse, Geneva & Corning Railroad. The gulfs on that road are perfectly characteristic of the Portage group.

Ms. | Southern Central Railroad—Continued.

54 Freeville.	11 a. Portage.	1043
56 Peruville.	"	
59 Groton.	"	990
65 Locke.	792" on 10 c. Gen.	
69 Moravia. ⁹⁸	"	785
73 Cascade. ⁹⁹	10 b. Hamilton.	717
76 Scipio.	" (Glen.)	
79 Wyckoff's. ⁹⁹	"	719
(Foot of Lake.)		
86 Auburn. ⁸⁰	9 c. Cornifer.	644
90 Throop.	6. Salina, 13 miles.	
95 Weedsport. ⁸³	"	417
99 Brick Church.	"	
104 Cato.	"	416
108 Ira.	5 c. Niagara.	
112 Martville.	5 c. Clinton.	
115 Sterling.	"	
116 Fair Haven.	5 a. Medina, 3 miles.	
118 N. Fair Haven ⁷¹	" Lake, 245.	

Utica, Ithaca and Elmira Railroad.

0 Elmira.	11 b. Chemung.	863
5 Horse Heads.	"	817
10 Breesport.	"	
14 Erin.	"	
17 Park.	"	
21 Swartwood.	"	
25 Van Etten.	"	
28 Spencer.	"	
32 West Candor.	"	
34 North Candor.	"	
37 Wilseyville.	"	918
42 White Church.	"	
44 Mott's Corners.	11 a. Portage.	
46 Besemer's.	"	
50 Ithaca. ⁸⁴	"	
53 Varna.	"	
54 Snyder's.	"	
57 Etna.	"	
60 Freeville.	"	
62 Malloryville.	"	
63 McLean.	"	
67 South Cortland.	100 "	
70 Cortland.	"	
71 D. L. & W. Depot	"	1111
0 Cortland.	11 a. Portage.	
12 Truxton.	"	
16 Cuyler.	"	
20 De Ruyter.	10 c. Genesee.	1276
0 De Ruyter.	10 c. Genesee.	1276
10 Otselic.	11 a. Portage.	
20 Plymouth.	11 b. Chemung.	
28 Norwich.	"	

Utica, Ithaca & Elmira Railroad—Continued.

Ms.	Scipio Branch.
0 Freeville.	11 a. Portage.
4 West Dryden.	"
7 Asbury Road.	"
10 South Lansing.	"
14 North Lansing.	"
17 Genoa.	"
23 Venice Centre.	"
27 Scipio.	"

New York & Oswego Midland Railroad.

New York, (Erie Railroad), N. W.	
0 Middletown.	4 c. Hudson River. 550
5 Fair Oaks.	"
10 Bloomingburg.	5 a. Oneida. 757
12 Wurtsboro.	Tunnel, 3,840 feet.
15 Summitville.	10. Hamilton, 11 a.
30 Fallsburg.	Portage & Chemung.
39 Liberty Falls.	12. Catskill. Tunnel.
40 Liberty.	" 1,017 ft.
46 Parkesville.	" 1798
51 Morseton.	11. Chemung.
63 Cook's Falls.	"
73 East Branch.	"
82 Hancock.	12. Cats'll. Tun'l, 1,160
89 Codorus Summit	" 1463 ft.
93 Rock Rift.	" 1152
101 Walton.	Junct'n of the 11. 1220
108 Zig Zag.	Chem. & 12. Catsk. 1685
117 Sidney Centre.	12. Catskill, synclinal.
125 Sidney Plains.	11 b. Chemung. 967
127 New Berlin Jun	"
134 Guilford.	" 1299
143 Oxford.	"
148 Norwich.	11 a. Portage. 763
163 Earlville.	10 c. Genesee.
167 Smith's Valley.	10 b. Hamilton.
172 Eaton.	10 a. Marcellus.
174 Morrisville.	9 c. Corniferous l. s. in hills.
181 Munnsville.	"
183 Cook's Corners.	6. Salina.
187 Oneida Comm'ty	5 c. Niagara.
190 Oneida.	5 b. Clinton. 412
192 Durhamville.	"
200 North Bay. ¹⁰²	"
209 Cleveland.	" Lake, 367
216 Constantia. ¹⁰²	"
223 Central Square.	"
230 Pennellville.	"
238 Fulton. ⁷⁵	5 a. Medina. 335
250 Oswego. ⁷¹	" Lake, 245.

87. The outlet of Crooked Lake from Penn Yan to Dresden is through the Genesee slate, Tully limestone, and the upper part of the Hamilton—all finely displayed. Crooked Lake is 20 miles long, one mile wide, 100 feet deep, and its surface is 718 feet above tide water. Its northern half is divided by a bluff of Portage (800 feet high) into two branches—one of them 12 and the other 8 miles long.

88. Canandaigua Lake is 14 miles long, from one to two miles wide, its surface is 668 feet above tide, and its greatest depth is 100 feet, but it is very shallow at both ends. It is excavated from the Hamilton and Portage groups.

89. The drift described in note 31 extends nearly to Dresden.

90. The fish beds are midway between Blossburg and Covington, in a cut called "Red Rock," where the formation is exposed for about 200 feet in thickness.

New York & Oswego Midland Railroad— Continued.			Ms. New York, Lake Erie & Western—Con.		
101 Walton.	(As before.)		47 Turner's.	4 a. Trenton limestone.	
105 Colchester.	12. Catskill.		49 Monroe.	4 c. Hudson River.	
109 Hawley's.	"		50 Schunemunk Mt	2 b. Potsdam.	
112 De Lancey's.	"		51 Oxford.	4 a. Trenton.	
118 Delhi.	"		53 Greycourt.	4 c. Hudson River, 25 m	
127 New Berlin Jun	11 b. Chemung.		59 Goshen.	"	480
134 Mount Upton.	"		66 Middletown.	"	559
140 Holmesville.	"		70 Howell's.	"	689
145 New Berlin Cen.	10. Hamilton.		75 Otisville, 106	"	886
149 New Berlin.	"		Kittatiny, Blue,	5 a. Oneida, or Shawan-	
0 Middletown.	4 c. Hudson River.		or Shawangunk	gunk and Medina.	
15 Summitville.	"		Mountain.	7. Lower Helderberg.	
17 Phillipsport.	"		87 Port Jervis, 101	8. Oriskany.	441
19 Homowack.	"			9. Cauda Galli & Up.	
23 Ellenville.	"and Trenton.			Heldg. & 10. Ham'n.	
New York, Lake Erie & Western Railroad. (Late Erie Railway).			Sparrowbush.	11 a. Portage.	
New York, 4	1 c. Montalban.		99 Pond Eddy.	11 b. Chemung.	571
0 Jersey City, 103	16. Triassic. Tunnel		106 Shohola.	"	
104	in Basalt, through		110 Lackawaxen ¹⁰⁷	"	648
(Tide Marshes.)	Bergen Hill.		116 Pine Grove.	"	
9 Rutherford Park	16. Triassic, 31 miles.		122 Narrowsb'rg ¹⁰⁷	"	714
11 Passaic.	" (Passaic Falls		131 Cochecton.	12. Catskill ridge.	
16 Paterson.	" } over Basalt.		135 Callicoon.	11 b. Chemung.	781
21 Ridgewood.	"	187	136	12. Catskill, (bluffs).	
23 Hohokus.	"		143 Hawkins.	"	
25 Allendale.	"		147 Basket.	"	
27 Ramsey's.	"		154 Lordville.	"	
31 Suffern, N.J. 105	1 a. Laurentian.	298	159 Stockport.	11 b. Chemung.	
33 Ramapo, N.Y.	"		163 Hancock.	12. Catskill.	926
34 Sterling Jun'c'n	"		172 Hale's Eddy.	11 b. Chemung.	
35 Sloatsburg.	"		176 Deposit.	"	1008
41 Southfield.	"		184 Summit.	1873 "Mt. to N. Cats.	
43 Greenwood, 105	"	590	192 Susquehanna ¹⁰⁸	"	911
			200 Great Bend.	"	884

91. Just south of the Erie Canal there is a deep cut in a bluff of Waterlime group.

92. Picturesque view of Pompey Valley.

93. Cazenovia Lake is a beautiful lake, $4\frac{1}{2}$ miles long, $\frac{3}{4}$ mile wide, and 70 feet deep, 1,189 feet above tide water, and is excavated in the Hamilton group. It discharges its waters into Chittenango Creek, which runs southward.

94. Lebanon and Earlville are both good localities for Hamilton fossils.

95. Extensive and beautiful view extending over Oneida Lake.

96. Canaseraga Falls similar to Chittenango Falls. Note 97.

97. The Falls are in sight in the valley to the west. Here Chittenango Creek falls 120 feet perpendicularly into a canon over the 9. Onondaga limestone, with the Corniferous bed over it, which forms the sides of the creek at the top of or above the Falls. Under the Onondaga limestone is the Oriskany sandstone, only six inches thick. Above the Falls the creek flows through a small, handsome valley, its lower sides formed of Marcellus, and the tops of the hills Hamilton.

98. Moravia is an excellent locality for Hamilton fossils. The Tully limestone, the dividing line between the Hamilton and Genesee, is half way up the hill sides, and appears to dip below the valley north of Locke. It is met with at the falls of Dry Creek, south of Moravia.

99. Owasco Lake is 10 miles long, a mile and a half wide at the north at Auburn, and a half mile at the south end, and 750 feet above tide water. The whole of the lake is in the Hamilton group.

100. Marl is here taken from the bottom of ponds; dried like bricks, and burnt into lime.

101. From Bloomingburg tunnel to Sidney, the geology is the same as from Port Jervis to Susquehanna on the Erie Railway.

102. Oneida Lake is 19 miles long, 6 miles wide, its greatest depth not over 40 feet, and in general it is quite shoal. Its surface is 367 feet above tide water. It is excavated in the 5 b. Clinton group the rocks of which appear on its south shore and west end. Its north shore is covered with sandy alluvium which is 100 feet deep at the east end and furnishes glass sand used in the glass factories in this vicinity.

103. The Erie railway tunnel at Jersey City is through Bergen Hill, which is the southern end of the mountain ridge of basalt or trap rock of the 16. Triassic age, 48 miles long, known farther north as the Palisade Mountain. See note 5.

104. The railroads out of New York through New Jersey pass over very extensive tide marshes, covered with reeds and coarse sedge grass, growing in soft mud, which is in some places forty feet deep, and all overflowed in high tide. These vast salt marshes so near New York City, which excite the wonder of strangers, contain from 250,000 to 300,000 acres or from 400 to 470 square miles.

Ms. New York, Lake Erie & Western—Con.			Ms. New York, Lake Erie & Western—Con.		
205	Kirkwood.	11 b. Chemung.	331	Hornellsville.	11 b. Chemung. 1161
214	Binghamton 108	" 868	340	Alfred.	"Summit, 1793.
223	Union.	"	349	Andover.	" 1511
229	Campville.	"	357	Genesee.	" 1384
236	Owego.	" 822	365	Phillipsville.	" 1539
246	Smithboro.	"	369	Belvidere.	" 1542 "Summit, 1698.
248	Barton.	"	373	Friendship.	" 1438
255	Waverly. 109	" 886	382	Cuba.	" 1438
260	Chemung.	"	389	Hindsdale.	" 1399
266	Wellsburg.	"	394	Olean.	" 1384
273	Elmira. 108	" 862	398	Allegany.	" 1346
290	Corning.	" 942	407	Carrollton.	" 888
301	Addison.	"	410	Great Valley.	" 607
331	Hornellsville.	" 1161	413	Salamanca.	"
343	Canaseraga.	"	421	Little Valley.	"
355	Nunda.	11 a. Portage.	428	Cattaraugus.	"
361	Portage. 110	" 1314	437	Dayton.	"
365	Castile.	"	440	Perrysburg.	"
374	Warsaw.	" 1326	447	Smith's Mills.	"
380	Dale.	"	451	Forestville.	"
391	Attica.	" 998	454	Sheridan.	11 a. Portage.
395	Griswold's.	10 b. Hamilton. 1044	459	Dunkirk.	" 607
397	Darien.	"			
403	Alden.	888 " & 9 c. Corn.	76	Avon. 111	9 c. Cor. & 6. Water Li.
408	Town Line.	9 c. Corniferous. 688	83	Caledonia.	"
412	Lancaster.	"	90	Le Roy.	"
420	East Buffalo.	" 611	94	Stafford.	"
422	Buffalo. 40	588 " Lake, 569.	100	Batavia. 41	889 "
	0 Corning.	11 b. Chemung. 943	107	Alexander.	10 b. Hamilton.
	1 Painted Post.	"	110	Attica.	11 a. Portage.
	5 Coopers'.	"			
	7 Curtis'.	"	76	Avon. 111	9 c. Corniferous.
	9 Campbell's.	"	80	South Avon.	" and Marcellus.
	14 Savona.	"	85	Geneseo.	10 b. Hamilton.
	20 Bath.	"	89	Cuylerville.	"
	23 Kanona.	"	90	Shaker's.	11 a. Chasaqua shale.
	27 Avoca.	"	91	Mt. Morris. 112	10 c. Genesee.
	80 Wallace's.	"	94	Sonyea.	"
	35 Liberty.	"	98	McNair.	"
	39 Blood's.	"	102	West Sparta.	11 a. Portage.
	45 Wayland.	"	106	Dansville. 112	"
	50 Springwater.	11 a. Portage.			
	53 Webster.	"			
	57 Conesus.	"			
	60 South Livonia.	11 b. Hamilton.			
	64 Livonia.	"			
	67 Hamilton.	"			
	76 Avon. 111	9 c. Cornif. and Water-			
	80 Rush.	6. Salina. lime.			
	82 Scottsville.	"			
	86 Henrietta.	"			
	90 Red Creek.	"			
	94 Rochester. 38	5 c. Niagara, 3 miles. 527			

Future generations may build dikes and reclaim them, but at present they are dismal swamps without a single tree or shrub, and wholly impassable to either man or beast. The two hills which rise abruptly in the salt meadow south of the Erie Railway and north of the Pennsylvania Railroad, are called Big Snake Hill and Little Snake Hill. The large one is half a mile long and 200 feet high. Both of these hills are outbursts of trap from between the underlying sandstone strata, similar to the Palisade Mountain.

105. Suffern to Greenwood. Here is a long natural gap through the Laurentian Highland range or Ramapo Mountains. Going west you go through a 2-4. Cambrian valley to Otisville. There is some Trenton limestone at Greenwood furnace and Turner's, but nearly all the surface for 30 miles is covered with Hudson River slates, the softer portions about Goshen forming a beautiful country.

Ms. Middletown and Crawford Railroad.		Branches of N. Y. L. E. & W.—Continued.	
0 Middletown.	4 c. Hudson River.	Ms. Walkill Valley Railroad.	
3 Crawford Junc.	"	0 Jersey City.	(See Main Line Erie R.)
5 Circleville.	"	59 Goshen. ¹⁰⁵	4 c. Hudson River.
8 Bellville.	"	61 Ripp's.	"
10 Thompson Rdge	"	64 Campbell Hall.	"
13 Pine Bush.	"	66 Neely Town.	"
Bath and Hammondsport Railroad.		68 Beaver Dam.	"
0 Bath.	11 b. Chemung.	69 Montgomery.	"
3 County House.	"	73 Walden.	"
5 Cold Spring.	"	76 Shawangunk.	{ 5 a. Oneida or Shaw'k Grit and Medina.
7 Pleasant Valley.	"	79 New Hurley.	{ 7. Lower Helderberg and 9. Upper Held'g, mainly Upper.
9 Hammondsport.	"	82 Gardner.	"
Branches of N. Y. L. E. & W. Piermont Branch.		85 Forest Glen.	"
0 Suffern.	16. Triassic.	87 New Platz.	"
9 Nanuet.	"	91 Springtown.	"
17 Piermont.	"	94 Rosendale. ¹¹⁴	4 c. Hudson River.
Northern Railroad of New Jersey.		96 Katson's Cave.	"
0 Jersey City.	16. Triassic. Trap dike	98 Whiteport.	"
6 New Durham.	" to Gran-	102 Kingston. ¹¹⁴	" & Water Li.
7 Granton.	" ton.	Monticello and Port Jervis Railroad.	
9 Ridgefield.	"	0 Port Jervis. ¹⁰	10. Hamilton. 441
12 Leonia.	"	6 Huguenot.	"
14 Englewood.	"	8 Rose Point.	11 b. Chemung.
15 Highland.	"	12 Paradise.	"
16 Tenafly.	"	13 Oakland.	"
17 Cresskill.	"	16 Hartwood.	"
19 Closter.	"	18 Gillman's.	"
21 Norwood.	"	20 Barnum's.	"
23 Tappan.	"	24 Monticello.	12. Catskill.
24 Sparkill.	"		
25 Piermont.	"		
29 Nyack.	"		

106. Otisville. One mile west of Otisville in the Erie Railway cut the 4 c. Hudson River shales are seen running under the 5 a. Oneida conglomerate. This is the dividing line between two of the great geological groups or periods, the Lower Silurian and Upper Silurian. In a moment the whole character of the country is changed from cultivated grazing land on the Hudson River shales, the Orange County milk country to the east of this line, to a poor, barren, rocky region on the Oneida or Shawangunk and Medina formations, showing in a striking manner how the character of the country depends on its geology. In descending the Shawangunk Mountain towards Port Jervis there is an alternation of beds of the Oneida conglomerate, which is of a light gray color, and the Medina sandstone, which is of a high red color. Some pockets of galena were discovered and mined here, but were soon exhausted. At Port Jervis we are in the Hamilton, a formation producing a country capable of supporting a population. The intermediate formations are very thin and compressed together.

107. Lackawaxen. From Port Jervis to Narrowsburg, the Delaware River and Erie Railway pass through a deep and crooked gorge about 25 miles long, exhibiting some of the wildest scenery in the country. The railroad is cut out of rock in many places and overhung as it were by ragged precipices.

108. Binghampton. West of Susquehanna the Erie Railway and its branches run for more than 800 miles on the 11 b. Chemung formation. Most of it is a fine fertile country with some handsome towns, the largest of which are Elmira and Binghampton, in valleys filled with gravel alluvium, and the higher country formed of the calcareous Chemung shales, is quite productive, much of it being a good grazing country; but there is no variety in its geology. East of Susquehanna the Chemung formation is composed of harder sandstone. It contains less calcareous shale, and the soil is poor. The country improves rapidly going westward from Susquehanna.

109. Just west of Waverly are the Chemung Narrows, where 100 feet of rock are exposed. The quarries have produced an abundance of characteristic fossils of the Chemung group in their greatest beauty and perfection, the formation having been named from this locality. Five miles south of Waverly the opening of the Susquehanna Valley may be seen, where the Chemung River from the west and the Susquehanna from the east unite and traverse the State of Pennsylvania to Chesapeake Bay. At the west end of Waverly Village is a curious flat-topped hill, about 60 feet high, called "Spanish Hill." It is an eddy hill of gravel formed in the drift period; but it can be seen to better advantage on the south side, at Sayre on the Pa. & N.Y. R. R. and the G. I. & S. R. R. There is a similar eddy hill in the village of Union.

Branches of N. Y. L. E. & W.—Continued.			Ms. Buffalo and Southwestern Railroad.		
Ms. Buffalo, Bradford & Pittsburg Railroad.			0 Buffalo. ⁴⁰	9 c. Corniferous.	578
0 Carrollton.	11 b. Chemung.	Bradford oil region.	3 Junction.	"	
6 Limestone.	"		5 Limestone Ridge	"	
11 Bradford's, Pa.	"		10 Abbott Road.	"	
14 De Golias, "	"		13 Hamburg.	10. Hamilton.	
19 Big Shanty, "	"		16 Eden Valley.	11 a. Portage.	
22 Crawford's, "	"		19 Eden Center.	"	
26 Gilesville, "	14. Coal Measures.		23 North Collins.	"	
Warwick Branch, S. W.			27 Lawton's.	11 b. Chemung.	
54 Greycourt.	4 c. Hudson River.		30 Collins.	"	
55 East Chester.	"		33 Gowanda.	"	
57 Sugar Loaf.	"		39 Dayton.	"	
58 Lake.	4 a. Trenton.		43 Pine Valley.	"	
63 Warwick.	"		48 Cherry Creek.	"	
Suspension Bridge and Niagara Falls Branch.			53 Clear Creek.	"	
420 Buffalo.	9 c. Corniferous.		56 Randolph.	"	
420 East Buffalo.	"		60 Kennedy.	"	
425 Main Street.	"		69 Jamestown. ¹¹⁵	"	
431 Tonawanda.	6. Salina.		Buffalo, Allegany Valley & Pittsburg R. R.		
437 La Salle.	"		From Dunkirk to Pennsylvania State line on 11 a. Portage and 11 b. Chemung.		
442 Niagara Falls. ⁸⁹	5 c. Niagara.		Buffalo, Corry and Pittsburg Railroad.		
443 Susp. Bridge. ⁴³	"		From Brockton, 11 b. Chemung.		
444 Clifton, Ont.	"		Atlantic and Great Western Railroad.		
Honesdale Branch. (See Pennsylvania.)			Part in New York, 11 b. Chemung. ¹¹⁵		
Jefferson Branch. (See Pennsylvania.)			Rochester and State Line Railroad.		
Ulster and Delaware Railroad.			0 Rochester.	5 c. Niagara.	488
0 Rondout. ¹¹⁴	{ 4 c. Hudson River.	This R. R. runs into the heart of the Catskill Mts.	5 Maplewood.	"	
4 Kingston.	{ 6. Water Lime.		7 Brookdale.	6. Salina.	
9 West Hurley.	7. Lower Helderberg.		11 Scottsville.	"	555
12 Olive Branch.	10. Hamilton.		14 Garbuttville.	6. Waterlime.	
15 Brooks' Cross'g	11 b. Chemung.		15 Wheatland.	"	611
17 Broadhead Bra.	11 a. Portage.		17 Mumford.	"	611
18 Shokan.	"		21 Lime Rock.	9 c. U. Helderberg.	770
21 Boiceville.	11. Chem. & 12. Cats.		25 Le Roy.	"	884
24 Mount Pleasant.	12. Catskill.		30 Pavilion Center.	10. Hamilton.	
27 Phoenicia.	"		33 Pavilion.	"	938
32 Fox Hollow.	"		38 Wyoming.	10 c. Genesee.	957
33 Shandaken.	"		43 Warsaw.	11 a. Portage.	1110
36 Big Indian.	"		48 Rock Glen.	"	1608
39 Pine Hill.	{ " Lowest pass		54 Gainesville.	"	
44 Griffin's Corners	{ of the Catskill Mts.		62 Bliss Corners.	"	
48 Dean's Corners.	12. Catskill.		65 Eagle Village.	" Summit, 1909.	
51 Kelly's Corners.	11. Chemung.		83 Machias.	1689 " & 11 b. Chem.	
53 Halcottville.	"		93 Ashford.	"	
57 Stratton's Falls.	12. Catskill.		97 Elliottsville.	"	1541
59 Roxbury.	"		102 Great Valley.	"	
65 Moresville.	"and Chemung.		108 Salamanca.	"	1890
74 Stamford.	"				

110. Portage. Here the railroad crosses the very deep gorge of the Genesee River on a high iron bridge 830 feet long and 235 feet high. There are three falls within a distance of two miles which are 60, 90 and 110 feet high, besides the intervening rapids. Two of them are visible from the car windows on the north side. The bridge crosses the upper falls. The river pursues a meandering course through this deep gorge and over these three successive cascades, descending more than 500 feet, and passes out into the Valley of the Genesee at Mount Morris. The gorge is 20 miles long by the river, or 14 by the public road, and its depth in some places is not less than 850 feet, its width only about 600 feet, and the banks nearly perpendicular. The place is well worth a visit. It is cut out of the 11 a. Portage group, except the lower end, which is in the 10 c. Genesee shale. The Portage group was named from this place. See note 112, Mount Morris. There is an ancient channel

Buffalo, New York and Philadelphia Railroad.			Ms. Harlem Extension Railroad.		
Ms.					
0 Buffalo. ⁴⁰	9 c. Corniferous.	578	0 Chatham 4 cor. 3 b. Quebec.		
13 Elma.	10. Hamilton.		5 Chatham.		
17 Aurora.	" & 11 a. Portg.		11 Rider's Mill.		
22 Wales.	"		18 New Lebanon.		
26 Holland.	"		27 Lebanon Spr'gs.		
29 Protection.	"		31 N. Stephentown		
36 Arcade.	11 a. Por. & 11 b. Chem.		34 Centre Berlin.		
39 Yorkshire.	"		39 Berlin.		
43 Machias.	"		44 Petersburg.		
50 Franklinville.	11 b. Chemung.		45 N. Petersburg.		
57 Ischua.	"		47 T. & B. Junction.		
63 Hindsdale.	"		53 Bennington, Vt.		
69 Olean.	"				
76 Portville.	"		Poughkeepsie, Hartford & Boston Railroad.		
84 Eldred, Pa.	12. Catskill.		0 Poughkeepsie.	3 b. Quebec. ¹¹⁶	
89 Larabees.	"		8 Russell's.	"	
97 Port Allegeny.	"		18 Standfordville.	"	
107 Keating Summit	"		26 Pine Plains.	"	
121 Emporium.	{ 14 a. Carboniferous, summit of hills.		30 Ancram Lead Mines.	"	
			34 Tanner's.	"	
			37 Boston Corners.	"	
			43 C.W. R.R. Jun.	"	
			Millerton.	"	
Lake Shore and Michigan Southern R.R.			Troy and Boston Railroad.		
0 Buffalo. ⁴⁰	9 c. Corniferous.	578	0 Troy.	{ 4 c. Hudson River & 3 b. Quebec. ¹¹⁶	
10 Hamburg.	10. Hamilton.		4 Lansingburgh.	"	
21 Angola.	"		9 Melrose.	3 b. Quebec.	
26 Farnham.	"		13 Schaghticoke.	"	
29 Irving.	"		14 Valley Falls.	"	
31 Silver Creek.	10 c. Genesee.		17 Johnsonville.	"	
40 Dunkirk.	11 a. Port. & Chemung.		21 Buskirk's.	"	
49 Brocton June'n.	"		24 Eagle Bridge.	"	
57 Westfield.	"		26 Hoosac June'n.	"	
65 Ripley, Pa.	"		State Line.	3 b. Quebec.	
73 North-East.	"		27 Hoosac Falls.	"	
80 Harbor Creek.	"		30 Hoosac.	3 b. & c. Stockbr'ge Ls.	
84 Wesleyville.	"		32 Petersburg.	2. Cambrian.	
88 Erie.	"		36 North Pownal.	"	
98 Fairview.	"		43 Williamstown.	"	
103 Girard, Pa.	"		45 Blackinton.	"	
115 Conneaut, Ohio.	11. Erie Shale.		48 North Adams.	1 f. Green Mt. gneiss.	
123 Kingsville.	"				
128 Ashtabula.	"				
(Continued in Ohio).					

from Portage to Nunda, filled up by drift, compelling the river to cut its present deep, tortuous channel. For other examples of this see notes 31, 35, 38 and 39.

111. Avon. You have 6. Waterlime, 9. Upper Helderberg, and 10 a. Marcellus shale in the creek.

112. To study the Genesee shales stop at Mount Morris. Go through the village one mile north-west to the mouth of the gorge, where the Genesee River, after running 20 miles through the deep canon from Portage, breaks out into the beautiful, broad and fertile Genesee Valley. There is a good section close to the bridge over the river. Get a boat and row one mile up the pool of the State dam, which flows to the foot of the precipices all that distance. This is the finest exposure of the 10 c. Genesee in the State, the typical locality from which it was named, and the scenery is in itself remarkably good. The cliffs are 100 to 200 feet perpendicular, full of *septaria*, like flattened cannon balls sticking in the walls. It is curious that so soft a shale rock should stand the weather so well and not form sloping banks when the edges only are exposed. See note No. 110. Portage.

113. Dansville is in a beautiful amphitheatre of Portage hills with very picturesque views from the Water Cure and other elevated points.

114. The Rosendale Cement, manufactured near Rondout, is from the 6. Waterlime rock, which is here between the Medina sandstone and the Lower Helderberg limestone, the intermediate formations being wanting. It is a light blue, fine grained limestone, with smooth conchoidal fracture. The same formation furnishes the Hydraulic Cement, made at Syracuse, N.Y., and elsewhere.

115. Jamestown. Chataqua Lake is 18 miles long, 2 miles wide, 1291 feet above tide water and 726 above Lake Erie. Its northern extremity is only 8 miles from Lake Erie, and yet it empties its waters by the Conewango, Alleghany, Ohio and Mississippi into the Atlantic. It is a beautiful sheet of water, bounded on its eastern side by gravelly sloping banks, and on the west by more level and in some places marshy shores. It is excavated in the Chemung group, the Portage being along its outlet and on the shores of Lake Erie below, but of much less thickness than further east.

Ms. | New York & Harlem R.R. 116, 117, 118

0 New York.	1 d. Montalban.
9 Fordham.	"
11 Williams Bridge.	"
14 W. Mt. Vernon.	"
16 Bronxville.	"
17 Tuckahoe.	" Marble.
20 Scarsdale.	"
22 White Plains.	"
31 Pleasantville.	" Marble.
33 Chappaqua.	1 a. Laurentian.
37 Mount Kisco.	"
40 Bedford.	" Feldspar pro-
45 Golden's Bridge.	duced for pot-
47 Purdy's.	teries.
48 Croton Falls.	Highlands.
53 Brewster's.	" Iron ore W.
56 Dykeman's.	" on summit.
61 Patterson.	"
64 Pawling.	3 b. Quebec.
71 South Dover.	" Iron ore W.
76 Dover Plains.	" Limest'e on E.
82 Wassaic.	"
84 Amenia. 119	" Iron ore W.
87 Sharon.	" Burden's gun
93 Millerton.	" bar'l iro. ore W.
97 Mount Riga.	" (Summit).
100 Boston Corners.	" Iron ore W.
106 Copake.	" Iron Works.
109 Hillsdale.	"
116 Martinsdale.	"
120 Philmont.	"
126 Ghent.	"
127 Chatham.	"

All the iron ore is produced on the west side—none on east side of railroad.

Newburg, Dutchess & Connecticut R. R.

0 New York.	3 b. Quebec group.
2 Matteawan.	" "See note 116
4 Glenham.	"
6 Fishkill.	"
12 Hopewell.	"
13 Clove Branch Ju	"
17 Sylvan Lake.	"
19 Billings.	"
25 Verbank.	"
30 Millbrook.	"
37 Bangall.	"
40 Stissing Junc'n.	"
45 Pine Plains.	"
47 Bethel.	"
50 Shekomoko.	"
54 Winchell's.	" [Quebec.
59 Millerton.	" Hills W. are

Ms. | New York and New Haven Railroad.

0 New York.	1 d. Montalban.
12 Williams Bridge.	"
15 Mount Vernon.	{ 20. Quaternary, underlaid by 1 c. Montalban, probably.
18 New Rochelle.	
22 Mamaroneck.	"
25 Rye.	"
27 Port Chester.	"
30 Greenwich.	"
31 Cos Cob Bridge.	"
35 Stamford, Conn.	"

Greenwich and Johnsonville Railroad.
Washington Co.

Troy.	
0 Johnsonville.	3 b. Quebec. 116 & 117
5 Lee's.	"
6 S. Cambridge.	"
8 W. Cambridge.	"
10 Summit.	"
13 Easton.	"
16 Greenwich.	"

Long Island Railroad.

0 Hunter's Point.	20. Quaternary.
10 Jamaica.	"
19 Mineola.	"
25 Hicksville.	"
29 Syosset.	"
34 Huntington.	"
40 Northport.	"
59 Port Jefferson.	"
80 Farmingdale.	"
65 Manor.	"
94 Greenport.	"

Flushing, North Shore & Central Railroad.

0 Hunter's Point.	20. Quaternary.
3 Woodside.	"
4 Winfield.	"
5 Newtown.	"
8 Flushing.	"
9 College Point.	"
11 Whitestone.	"
14 Brookdale.	"

Staten Island Railroad.

Stapleton.	{ 18 c. Cretaceous. (Plastic clay formation).
Richmond.	"
Pleasant Plains.	"
Tottenville.	"

116. Quebec Group. The geology of the country between the Hudson River and the Connecticut and Massachusetts state line is yet involved in considerable doubt, and while the name Quebec group is here given, it should be understood that the precise geological horizon of the places is much less certain than in the portion of the State west of the river, where all the formations can be identified by characteristic fossils, as well as by their superposition and well marked lithological appearances. When the State geological survey was made, forty years ago, these extensive deposits of slate rocks were called Hudson River slates. Afterwards, in accordance with the Canada survey, they were called the Quebec group, by which they are yet designated as a general title, for

Ms. South Side Railroad of Long Island.			Ms. Boston and Albany Railroad.		
0 Brooklyn.	20. Quaternary.		0 Albany.	4 c. Hudson River.	
8 Richmond Hill.	"		1 Greenbush.	"	
10 Jamaica.	"		9 Schodack.	"	
16 Valley Stream.	"		17 Kinderhook.	"	116 & 117
19 Ocean Point.	"		20 Chatham Centre	3 b. Quebec.	
21 Far Rockaway.	"		24 Chatham.	"	
25 Sea Side House.	"		29 East Chatham.	"	
22 Freeport.	"		34 Canaan.	"	
36 Babylon.	"		39 State Line.	"	
47 Oakdale.	"		(Continued in Massachusetts).		
54 Patchogue.	"		Hudson and Chatham Branch.		
Geneva and Lyons			0 Hudson.	4 c. Hudson River.	
Division of N. Y. C. & H. R. R. R.			4 Claverack.	3 b. Quebec.	
0 Geneva. ²¹	{ Deep drift, overlying 6. Salina and 9 c. Corniferous. 453		9 Millerville.	"	116 & 117
14 Lyons.		6. Salina. 299	11 Pulver's.	"	
			15 Ghent.	"	
			17 Chatham.	"	
Troy and Schenectady			Rhinebeck and Connecticut Railroad.		
Division of N. Y. C. & H. R. R. R.			0 Rhinecliff.	4 c. Hudson River.	
148 Troy.	4 c. Hudson River.		3 Rhinebeck.	"	
151 Cohoes.	" Falls, 70 ft.		7 Red Hook.	3 b. Quebec.	
154 Crescent.	"		11 Spring Lake.	"	116 & 117
160 Niskayuna.	"		17 Jackson Corners	"	
166 Aqueduct.	"		25 Ancram.	"	
170 Schenectady.	"		35 Boston Corners.	"	
			42 State Line.	"	
			Connecticut Western R. R. Junction.		

the want of a more definite term. They are probably composed of several formations which have not been minutely studied, and are so metamorphosed, contorted, broken and wrinkled in almost every conceivable manner, and so disturbed, inverted and involved with each other, that at present their precise geology cannot be stated. See note 117 on this subject, by Prof. T. S. Hunt.

117. GEOLOGY OF EASTERN NEW YORK.—To the east of the Hudson River in New York we find besides the Laurentian rocks of the Highlands, and small portions of Huronian, a great development of the gneiss and mica-schists of the Montalban and of two other and very unlike series. The first of these is the Lower Taconic, consisting of the Stockbridge limestone with quartzite and peculiar slates. This series, together with the Primary crystalline schists, stretches up northward, passing along the southeast side of the Highlands, and occupying portions of Eastern New York and Western New England. On the northwest side of the Highlands, extending northward along the valley of the Hudson, and as far as Lake Champlain, is found another series, variously designated as the Hudson River group of Mather, the Taconic Slates or Upper Taconic series of Emmons, and the Quebec group of Logan. These rocks have been supposed to be Upper Cambrian or Silurian, (Utica, Lorraine and Oneida) but are now believed to be chiefly of Lower and Middle Cambrian ages (including Sillery and Levis). They are generally disturbed and often inverted, and include small outcrops and involved portions of Upper Cambrian and occasionally of Silurian strata. This Hudson River and Upper Taconic group is distinct from and superior to the Lower Taconic. It is impossible in the present state of our knowledge of their distribution to define the limits of these various groups of strata to the east of the Hudson, or to say at what stations the Upper Taconic, the Lower Taconic or the Primary rocks are met with.

T. S. HUNT.

118. GEOLOGY OF THE HARLEM RAILROAD.—The Laurentian mountains forming the Highlands on the Hudson River, from Peekskill nearly to Fishkill, (see note 6), extend as mountains only about sixteen miles east of that river. The Harlem Railroad runs through valleys, and the Highlands are not observable as a prominent ridge. But the series of formations is the same as on the river, consisting first of the Laurentian foundation rocks; then, south of these, the later crystalline series to New York City. North of the Laurentian, is the *Great Valley*, a thousand miles long, made up of the groups variously called Taconic, Quebec, Cambrian or Lower Silurian. This valley, geographically at least, runs across the River Hudson at Newburg and Fishkill, (see note 7), and then runs through the Taconic or Quebec belt to the City of Quebec in Canada. This district has been for a long time the great battle-field of geologists. Its geology can perhaps safely be inferred to be the same as in other portions of the same valley, where, from its fossils and the rocks above and below, its place in the series can be fixed beyond question.

119. The limestones and sandstones used for flagging and building in the various cities along the line of the N. Y. C. & H. R. R. R. are as follows: At Albany, Schenectady, Utica and Rome, 4 a. Trenton limestone, generally of the Birdseye portion, which produces the thickest stone; at Syracuse, Auburn and Geneva, the 8. Upper Helderberg, generally the Onondaga or lower portion of it; from Rochester to Buffalo the 5 a. Medina sandstone is the favorite for these purposes. Some 5. Niagara limestone are used at Rochester and 9. Upper Helderberg or Corniferous at Buffalo, especially for lime burning. But the best flagstones are from the Hamilton and Chemung formations, and generally come from the shores of Cayuga Lake. Large quantities of flagstones are also brought from the upper part of the Hamilton group in the higher parts of the Helderberg, and from the same geological position along the west side of the River Hudson from below Catskill as far as Kingston.

New Jersey.¹

List of the Geological Formations on the New Jersey Railroads.

20. Quaternary, or Recent.	16. Triassic, or New Red Sandstone.
19. Tertiary (Southern New Jersey.)	5 a. Medina s.s. and Oneida Conglom.
18. Cretaceous.	4 c. Cincinnati, or Hudson River.
“ g. Upper Marl. ²	4 a. Trenton Limestone.
“ f. Yellow Sand.	2 b. Potsdam (Green Pond Mt.)
“ e. Middle Marl. ²	1 b. Huronian (at Trenton.)
“ d. Red Sand.	1 a. Laurentian. Gneiss, Crystalline
“ c. Lower Marl. ²	Limestone, &c.
“ b. Clay Marls.	(The Highland Range.)
“ a. Plastic Clays.	

² Producing the green sand marl used in agriculture.

1 Pennsylvania Railroad. (United Railways of New Jersey.)		Ms. 3 Perth, Amboy and Woodbridge R.R.	
0 New York.	1 b. Huronian. ²	0 New York.	16. Triassic.
1 Jersey City.	16. Triassic.	19 Rahway.	
9 Newark.	“	21 Junction.	
14 Elizabeth.	“	24 Woodbridge.	18. Cret's. a. plastic clay
19 Rahway.	“	27 Perth Amboy.	“
23 Uniontown.	“	4 Millstone and New Brunswick R. R.	
26 Metuchen.	“	0 New York.	
31 N. Brunswick.	“	31 N. Brunswick.	16. Triassic.
41 Monmouth J.	18. Cret's. a. plastic clay	34 Millstone Junc.	“
46 Plainsboro.	“	46 Middlebush.	“
47 Princeton Jun.	“	39 E. Millstone.	“
57 Trenton.	1 b. Huronian. ²	5 Rocky Hill Branch.	
67 Bristol, Pa.	“	0 New York.	
86 Germantown J.	“	41 Monmouth Jn.	18. Cret's. a. plastic clay
86 Mantua.	“	46 Kingston.	16. Triassic.
90 W. Philad'a.	“	48 Rocky Hill.	“ Trap Di.
47 Princeton Jun.	11. Cret's. a. plastic clay	6 Freehold, Jamesburg and Squankum.	
49 Princeton.	16. Triassic. (E. edge.)	41 Monmouth J.	18. Cret's. a. plastic clay.
57 Trenton.	1 b. Huronian. ²	43 Dayton.	“
68 Bordertown.	18. Cretaceous (a. and b.)	47 Jamesburg.	“
2 Amboy Division.		52 Englishtown.	“ b. clay marl
0 South Amboy.	18. Cret's. a. plastic clay	18 Cretaceous.	
8 Old Bridge.	“	“ d. red sand.	
14 Jamesburg.	“	“ e. mid. marl.	
18 Cranberry.	“ b. clay marl.	“ f. yel'w sand.	
21 Hightstown.	“	“ g. upper marl	
24 Windsor.	“	65 Farmingdale. ⁴	
27 Newtown.	“	74 Sea Girt.	
31 Yardleyville.	“	19. Tertiary.	
34 Bordertown.	“	7 Belvidere Division.	
39 Florence.	“ a. plastic clay.	0 Philadelphia.	
43 Burlington.	“	30 Trenton.	1 b. Huronian. ²
47 Beverly.	“	36 Greensburg.	16. Triassic.
50 Riverside.	“	38 Somerset Jun.	“
54 Palmyra.	“	40 Wash. Cross'g.	“
61 Camden.	“	41 Titusville.	“ Trap Di.
62 Philadelphia.	1 b. Huronian. ²	43 Moore's.	“
		46 Lambertville.	“ (Goat Hill)
		4. Green sand marl grits.	

1. The excellent Reports on the Geology of New Jersey, by Prof's H. D. Rogers, Wm. Kittell and Geo. H. Cook, with the large and beautiful Geological Map by Prof. Cook, and the author's own observations, are the authorities for the geology of the Railway Guide of this State. It has also been revised and corrected by Prof. John C. Smock, the Assistant State Geologist.

2. New York, Trenton and Philadelphia are on Dr. T. S. Hunt's 1 d. Montalban. (See Canada.)

Ms. Belvidere Division—Continued.		Ms. 11 Camden and Atlantic R. R.	
50 Stockton.	16. Triassic.	0 Camden.	18. Cret's. a. plastic clay.
56 Pt. Pleasant.	" Trap Dike.	7 Haddonfield.	" b. clay marl.
62 Frenchtown.	"		" d. red sand.
68 Holland.	" Trias. congl.	10 Ashland.	" e. middle marl
(Muscone'g M.)	1 a. Laurentian.		" g. upper marl.
72 Riegelsville.	4 a. Trenton.	16 Berlin.	19. Tertiary.
(Pohatcong M.)	1 a. Laurentian.	19 Atco.	"
75 Carpenterville.	4 a. Trenton.	23 Waterford.	"
80 Lehigh Junc.	"	25 Ancora.	"
81 Phillipsburg.	"	27 Winslow.	"
(Marble Mt.)	1 a. Laurentian.	30 Hammontown.	"
88 Martin's Creek.	4 a. Trenton.	32 De Costa.	"
95 Belvidere.	" & 4 c. Hudson.	37 Elwood.	"
46 Lambertville.	16. Triassic.	42 Egg Harb. City	"
56 Flemington.	"	48 May's Landing.	"
8 Mercer and Somerset R. R.		46 Pomona.	"
(Trenton.		52 Atsecon.	"
0 Somerset Jun.	16. Triassic.	59 Atlantic City.	20. Quaternary.
5 Pennington.	"	19 Atco.	19. Tertiary.
10 Hopewell.	"	28 Atston.	"
16 Harbinger.	"	12 West Jersey R. R.	
23 E. Millstone.	"	0 Philadelphia.	1 b. Huronian.
30 N. Brunswick.	"	2 Camden.	18. Cretaceous.
9 Delaware and Boundbrook.			" a. Plastic clay
(New Route, New York to Philadelphia)		4 Gloucester.	" b. Clay marl.
0 New York.			" c. Lower marl
1 Jersey City.	16. Triassic.	8 Woodbury.	" d. Red sand.
8 Bergen Point.	"		" e. Middle marl
12 Elizabeth.	"		" f. yellow sand.
24 Plainfield.	"	18 Glassboro.	19. Tertiary.
31 Bound Brook.	"	24 Franklinville.	"
35 Weston.	"	35 Vineland.	"
37 Hamilton.	"	39 Millville.	"
41 Vanaken.	"	59 Mt. Pleasant.	"
42 Harlingen.	"	81 Cape May.	"
45 Skillman.	"	18 Glassboro.	"
48 Hopewell.	"	26 Elmer.	"
53 Pennington.	"	37 Bridgeton.	"
58 Trenton Junc.	"	26 Elmer.	"
60 Yardley, Pa.	"	34 Yorkstown.	"
65 Woodbourne.	"	38 Alloway.	"
67 Langhorne.	"	39 Middletown.	"
73 Somerton.	1 b. Huronian.	43 Salem.	"
76 Bethayres.	"	13 New Jersey Southern.	
80 Jenkintown.	"	New York.	
88 Philadelphia.	"	0 Sandy Hook.	20. Quaternary.
10 Camden and Burlington County R. R.		7 Seabright.	"
0 Philadelphia.		11 Long Branch.	" e. middle marl
1 Camden.	18. Cret's. a. plastic clay.	16 Eatontown.	" "
9 Moorestown.	" b. clay marl.	22 Shark River.	" f. yel'w sand.
19 Mt. Holly.	" c. lower marl.	26 Farmingdale.	" g. upper marl.
25 Pemberton.	" e. middle marl	27 Squankum.	" "
26 New Egypt.	" f. yel'w sand.	33 Bricksburg.	19. Tertiary.
44 Imlaystown.	" g. upper marl	41 Manchester.	"
51 Hightstown.	" c. lower marl.	47 Whiting's.	"
	" b. clay marl.	47 Whiting's.	"

Ms. | New Jersey Southern—Continued.

59 Shamony.	19. Tertiary.
71 Atsion.	"
79 Winslow Junc.	"
85 Cedar Lake.	"
95 Vineland.	"
107 Bridgeport.	"
114 Greenwich.	"
117 Bay Side.	"
47 Whittings.	"
55 Hanover.	"
61 New Lisbon.	"
65 Pemberton Jn.	"
Camden.	18. Cretaceous.
Philadelphia.	

(Tom's River Branch.)

0 Sandy Hook.	20. Quaternary.
41 Manchester.	19. Tertiary.
49 Tom's River.	"
54 Cedar Creek.	"
60 Waretown.	"
61 Barnegat Jun.	"

Port Monmouth Branch (N.)

0 Sandy Hook.	20. Quaternary.
16 Eatontown.	19. Cret's, e. midl. marl.
17 Shrewsbury.	"
19 Red Bank.	" { d. red sand.
	" { c. lower marl.
25 Ft. Monmouth.	" b. clay marl.

14 Central R. R. of New Jersey.

0 New York.	16. Triassic.
1 Jersey City.	"
8 Bergen Point.	"
12 Elizabeth.	"
24 Plainfield.	"
31 Bound Brook.	"
36 Somerville.	"
45 White House.	"
Pickels Mt. on S.	" Trap Dike.
50 Lebanon.	"
52 Annandale.	1 a. Laurentian.
54 High Bridge.	"
58 Glen Garden.	"
59 N. Hampton J.	"
61 Asbury.	4 a. Trenton.
64 Valley.	"
66 Bloomsbury.	"
(Pohat'g Mt.)	1 a. Laurentian.
69 Springtown.	4 a. Trenton.
74 Phillipsburg.	"
75 Easton.	"

(Contin'd in Pa.)

(High Bridge and Chester Branch.)

54 High Bridge.	1 a. Laurentian.
59 California.	"
62 (Germ. Valley)	4 a. Trenton.
67 Chester.	1 a. Laurentian.

15 Lehigh Valley R. R.

Ms. | (Easton and Amboy Division.)

0 New York.	
1 Jersey City.	{ 16. Triassic. Deep
Bergen Hill.	{ rock-cut in Trap-dike.
9 Newark.	"
14 Elizabeth.	"
19 Rahway.	"
20 Metuchen.	"
0 Perth Amboy.	18. Cret's. a. plastic clay.
6 Ford's.	"
7 Metuchen.	16. Triassic.
20 Metuchen.	"
23 S. Plainfield.	"
26 Newmarket.	"
30 Bound Brook.	"
35 S. Somerville.	"
38 Flagtown.	"
41 Neshanic.	"
45 Three Bridges.	"
51 Flemington J.	"
54 Lansdown.	"
57 Midvale.	"
61 Pattenburg.	1 a. Laurentian.
(Tunnel 1 mile	"
in Musconetcong Mt.)	"
62 West End.	"
65 Bloomsbury.	4 a. Trenton.
(Pohatcong Mt.	on N.)
69 Kennedy.	1 a. Laurentian.
73 Phillipsburg.	4 a. Trenton.
74 Easton.	"

16 Delaware, Lackawanna and Western.

(Morris and Essex Division, or Main Line.)

0 New York.	16. Triassic.
2 Hoboken.	"
Tun'l. in Trap.	"
10 Newark.	"
13 Orange.	"
15 South Orange.	"
19 Millburn.	" Trap 1st Mt.
22 Summit.	" " 2d Mt.
25 Chatham.	" Long Hill, S.
31 Morristown.	"
34 Morris Plains.	"
38 Denville.	1 a. Laurentian.
40 Rockaway.	"
43 Dover.	"
48 Drakesville.	"
53 Stanhope.	"
56 Waterloo.	"
62 Hackettstown.	4 a. Trenton.
68 Port Murray.	" & 4 c. Hudson.
71 Washington.	1 a. Laur. & 2 c. Potsdam.
80 Stewartsville.	4 a. Trenton.
85 Phillipsburg.	"
86 Easton.	"

Iron ore
District.

Ms. 16 Main Line—Continued.			22 Sussex Railroad. (Branch of Morris and Essex.)		
71	Washington.	{ 1 a. Laurentian. (Pohatcong Mt.)	Waterloo.	1 a. Laurentian.	Gneiss.
75	Oxt'rd Furnace	{ Tunnel (Scott's Mt. W.)	5 Whitehall.	"	"
80	Bridgeville.	{ 2 b. Pots. & 4 a. Trent.	6 Andover.	{ 4 a. Trenton.	
		" " "		{ 4 c. Hudson River.	
82	Manunka Ch'h.	{ 4 c. Hudson River.	10 Newton.	4 a. Trenton.	
	(Tunnel.)	{ Jenny Jump Mt. on E.	13 Branchville J.	"	
84	Delaware.	{ 1 a. Laurentian.)	14 Lafayette.	"	
87	Portland, Pa.	4. c. Hudson River.	15 Augusta.	{ 4 c. Hudson River.	
		"		{ 4 a. Trenton.	
90	Columbia, Pa.	{ 4 a. Trenton.	19 Branchville.	4 c. Hudson.	
		{ 4 c. Hudson Riv. 2 ms			
		{ 5 a. Oneida conglom.	13 Branchville J.	{ 4 a. Trenton.	
92	Water Gap, Pa.	{ and Medina s. s.	18 Sparta.	{ 4 c. Hudson, 1 m.	
	(Contin'd in Pa.)	{ (Blue Mountain.)		4 c. Trenton.	
			21 Franklin.	"	(Zinc mine.)
17 Boonton Branch.			24 Montclair and Greenwood Lake R. R.		
0	New York.	1 b. Huronian.	9 Jersey City.	16 Triassic.	
2	Hoboken.	16. Triassic.	9 N. Newark.	"	
9	Rutherford Pk.	"	11 Bloomfield.	"	
12	Passaic.	"	12 Montclair.	"	
17	Paterson.	" Trap 1st Mt.	14 Montcl. H'ghts.	"	Trap Dike.
	Little Falls.	"	15 Great Notch.	"	" (1st Mt.)
25	Lincoln Park.	"	16 Cedar Grove.	"	"
27	Whitehall.	"	17 Little Falls.	"	" (2d Mt.)
29	Montville.	" Trias. congl.	19 Mountain View	"	
32	Boonton.	1 a. Laur. Ramapo Mt.	23 Pequannock.	"	
37	Denville.	"	24 Pompton Pl'ns.	"	
70	Washington.	By main line above.	28 Pompton.	1 a. Laurent. Ramapo Mt	
86	Easton.	"	32 Medvale.	"	
Branches to Iron Ore Mines, from Morris and Essex Division.			36 Ringwood Jun.	"	
18 Hibernia Mine R. R.			37 " Park	"	
40	Rockaway.	1 a. Laurentian.	38 Monk's.	"	
42	Beach Glen.	"	40 Hewitt.	"	
44	Hibernia.	"	43 Cooper.	"	
			45 Lake Side.	"	
			50 Greenw'd Lake	"	
19 Mount Hope Mine R. R.			25 New Jersey Midland R. R.		
40	Rockaway.	1 a. Laurentian.	0 Jersey City.	16. Triassic.	
42	Mt. Hope.	"	13 Hackensack.	"	
20 Port Oran and Mt. Hope R. R.			20 Paterson.	"	
43	Dover.	1 a. Laurentian.	22 Hawthorne.	"	
44	Port Oran Jun.	"	26 Wortendyke.	"	
47	Mt. Hope.	"	35 Pompton Jun.	1 a. Laurentian.	
21 Chester Railroad.			36 Bloomingdale.	"	
43	Dover.	1 a. Laurentian.	37 W. Bloomingd.	2 b. Potsdam and congl.	
46	Chester Jun.	"	47 Newfoundland.	" (Green Pond Mt.)	
49	Suckasunny.	"	56 Ogdensburg.	1 a. Laurentian.	
55	Chester.	"	57 Sterling Hill. ⁵	" cryst. l. s.	
	(Schooley's Mt. to the West.)		58 Franklin. ⁵	"	
22 Ogden Mine R. R.			(German Flats)	4 a. Magnesian l. s.	
10	miles R. R. Ogden Mine to Morris Canal.		66 Deckertown.	4 c. Hudson River.	
53	Stanhope.	1 a. Laurentian.	74 Unionville.	"	
56	Morris Canal.	"	88 Middlet'n, N.Y.	"	
60	Hopate'ng lake	"	5 Zinc ore mines at these places in the crystal- line limestone; also Franklinite.		
64	4 miles by lake	"	26 Erie Railway.		
70	Ogden Mine.	"	(The New Jersey portion of this R. R. is given with those of the State of New York.)		

Pennsylvania.

By PROFESSOR J. P. LESLEY, THE STATE GEOLOGIST.

List of the Geological Formations of Pennsylvania.

Prof. Dana's Table of the Formations.	Names Provisionally adopted in the Second Geological Survey of Pennsylvania, by Prof. J. P. Lesley.	Old Penn. Nos. of 1st Geo. Sur.
20. Quaternary.	20. Quaternary.	
16. Triassic.	16. Triassic.	
14 c. Upper Coal Measures.	14 c. Upper Barren Measures.	XIII.
" "	" Monongahela Riv. Coal Series.	"
14 b. Lower Coal Measures.	14 b. Lower Barren Measures.	"
" "	" Allegheny River Coal Series.	"
14 a. Millstone Grit.	14 a. Pottsville Conglomerate.	XII.
18 b. Upper Subcarboniferous.	13 b. Mauch Chunk Red Shale, (Umbral.)	XI.
18 a. Lower Subcarboniferous.	13 a. Pocono Grey Sandstone, (Vespertine.)	X.
12. Catskill.	12. Catskill Red s. s. (Ponent.)	IX.
11 b. Chemung.	11 b. Chemung.	VIII.
11 a. Portage.	11 a. Portage.	"
10. Hamilton, { Genesee.	10 c. Genesee.	"
" Hamilton.	10 b. Hamilton.	"
" Marcellus.	10 a. Marcellus.	"
9. Corniferous.	9. Upper Helderberg.	"
8. Oriskany.	8. Oriskany.	VII.
7. Lower Helderberg.	7. Lower Helderberg, (Lewistown Limestone.)	VI.
5 b. Clinton.	5 b. Clinton.	V.
5 a. Medina and Oneida.	5 a. Medina.	IV.
" "	" Oneida.	"
4 c. Cincinnati.	4 c. Hudson River.	III.
4 b. Utica.	4 b. Utica.	"
4 a. Trenton.	4 a. Trenton.	II.
3. Canadian.	3 a. Calciferous.	"
2. Primordial or Cambrian.	2 b. Potsdam.	I.
1. Archæan.	1. Azoic.	

NOTES ON THE TABLE OF FORMATIONS.—All beneath the Potsdam is styled Azoic, because no survey has yet sufficiently differentiated the mass into its several systems. The term Eozoic is rejected partly because both too vague and too shifting, and partly because it would suit the Cambrian system better than the Huronian and Laurentian, both of which remain to all intents and purposes Azoic. The terms Huronian and Laurentian are known to apply lithologically to rock masses in Pennsylvania, but their geographical relationships in the State are but imperfectly made out.

Much uncertainty still exists about the lines of demarcation between some of the formations in Pennsylvania, such as between the Catskill and Chemung; the Lower Helderberg and Clinton; the Hudson River and Utica; the Calciferous and Potsdam.

Niagara, Onondaga or Salina, Corniferous and other names are omitted because of their uncertain presence in many districts of the State; and because of the narrowness of their upturned outcrops where they do exist.

Some of the places named in the following lists occupy positions covering the width of two or more steeply outcropping formations, to any one of which therefore they might be assigned.

In the northern and western counties it is often impossible to say precisely whether places stand upon Chemung, Catskill, Pocono or Mauch Chunk rocks. In such cases, Chemung has been preferred, because the others might be studied in the surrounding hills on account of the general horizontality of the bedding.

J. P. L.

Pennsylvania.

Pennsylvania Railroad. New York Division.		Pennsylvania Railroad. Pennsylvania Division—Main Line—Con.	
Ms.		Ms.	
0 W. Philadelphia.	1. Azoic.	61 Bird-in-Hand.	{ 2-4. Siluro-Cambrian
6 Kensington. ¹	20. Quaternary.		Limestones.
18 Holmesburg.	"	69 Lancaster.	"
23 Bristol.	"	76 Landisville. ⁵	"
26 Tullytown.	"	81 Mount Joy.	"
32 Morrisville.	1. Azoic.	87 Elizabethtown. ⁶	16. Triassic.
33 Trenton, N. J.	(See New Jersey.)	95 Branch Inter. ⁷	"
		96 Middletown.	"
Pennsylvania Division—Main Line.			
0 W. Philadelphia.	1. Azoic.	106 Harrisburg.	{ 4 a. Trenton Lime-
5 Merion.	"		stone and edge of
9 Bryn Mawr.	"		4 b. Utica Slate.
20 Paoli.	"	111 Rockville. ⁸	4 c. Hudson Riv. Slate.
22 Malvern.	"	113 Marysville.	5 a. Oneida Conglom'e.
28 Oakland. ³	{ 2-4. Siluro-Cambrian.	120 Duncannon. ⁹	12. Catskill s. s. }
	(Calciferous ?)	133 Newport.	11 b. Chemung. }
	{ 3 a. & 4 a. Magnesian	138 Millerstown. ¹⁰	{ 5 b. Clinton and fossil
33 Downingtown.	Limesto's & Marbles.		iron ore beds.
39 Coatesville.	"	143 Thompsonstown.	7. Lower Helderberg.
44 Parkersburg.	2 b. Potsdam s. s.	148 Tuscarora.	10. Hamilton.
47 Penningtonville.	"	152 Perrysville. ¹¹	"
51 Gap. ⁸	1. Azoic.	155 Mifflin.	5 b. Clinton.
	{ 2-4. Siluro-Cambrian	162 Narrows. ¹²	"
57 Lemon Place. ⁴	Limestones.	167 Lewistown.	7. Lower Helderberg.
		178 McVeytown. ¹³	"

1. This line runs along the Delaware river over alluvion and modified glacial drift, based upon Azoic rocks, upon which lie the bottom layers of the Cretaceous of New Jersey.

2. Here the line finally leaves the Azoic rocks, across a fault, and passes white marble quarries to the Westchester Valley, rocks vertical, and probably identical with those of western Vermont, (Taconic ?)

3. Beds of quicksand. Wharton's famous nickel mine not far off.

4. From here to Elizabethtown, over the garden of Pennsylvania, the great limestone plain of Lancaster; steep dips; plications and faults innumerable; geology wholly unknown.

5. Zinc mines recently opened and worked one mile to the east.

6. Road runs for a mile or two along the back of a greenstone trap dike, twenty miles long, extending from the Cornwall iron mines near Lebanon, to the Susquehanna river at Falmouth, and over it into the great greenstone trap region of York County. Good place to study the action of the trap rock in metamorphosing the beds of New Red.

7. Commencement of the great cross section of the Paleozoic Rocks, and south edge of the limestones of the Great Valley.

8. Finest section in the State here. Seven miles thickness of rock, nearly vertical but slightly overturned, so that the upper formations seem to plunge beneath the lower—may here be measured, viz: From the Hudson River slates (Lower Silurian, or Siluro-Cambrian), up to the Coal Measures on the summit of the Third Mountain.

9. Here a greenstone trap dike, only 4 feet thick, 35 miles long, crosses the road and river. It carries iron ore. One mile west a coal bed is opened in the Pocono Sandstone, the representative of the New River Coal System of Montgomery County in Virginia. Five miles east, in the notch in the summit of Peter's (Fourth) Mountain, where the Dauphin-Halifax turnpike crosses its crest, is a vertical wall scored horizontally with *glacial striae*. Notice the terrace which the Catskill makes on the north flank of Peter's Mountain opposite Duncannon; it is the finest exhibition of Catskill terrace erosion in the State. See Notes 77 and 170.

10. Clinton fossil ore bed extensively worked here and at Mifflin.

11. Best place to study the Juniata River coal system, (Hamilton; Lower Devonian).

12. Long Narrows. River flows in a narrow synclinal between anticlinals of Medina and Oneida.

13. Best place to study Oriskany glass sand quarries, one mile back of McVeytown on the opposite (north) side of river.

Pennsylvania Railroad.		Pennsylvania Railroad.	
Ms.	Pennsylvania Division—Main Line—Con.	Ms.	Pennsylvania Division—Main Line—Con.
188	Newton Hamill'n	10.	Hamilton.
191	Mount Union.	5 b.	Clinton.
195	Mapleton. ¹⁴	7.	Lower Helderberg.
203	Huntingdon. ¹⁵	11 a.	Portage.
210	Petersburg.	5 b.	Clinton Red Shale.
216	Spruce Creek. ¹⁶	4 a.	Trenton Limestone.
220	Birmingham. ¹⁷	3 a.	Calceferous.
233	Tyrone.	5 b.	Clinton.
227	Tipton.	10.	Hamilton.
231	Bell's Mills. ¹⁸	"	"
237	Altoona.	"	"
242	Kittanning Pt. ¹⁹	12.	Catskill.
249	Gallitzin.	{ 14 b. Coal Measures of the Allegheny River Series.	
252	Cresson.		
255	Lilly. ²⁰		
262	Wilmore.	"	"
265	South Fork. ²¹	"	"
269	Mineral Point.	"	"
274	Conemaugh.	"	"
286	Johnstown.	"	"
285	Ninevah.	"	"
290	New Florence.	"	"
295	Bolivar. ²²	"	"
301	Blairsville Int ²³	"	"
308	Derry.	14 b. L. Barren Measu's.	
		14 c. Monongahela Riv.	
		Series of C. M.	
313	Latrobe. ²⁴	"	"
323	Greensburg.	"	"
328	Penn.	"	"
333	Irwin's.	"	"
343	Brinton's.	"	"
347	Wilksburg.	14 b. L. Barren Measur.	
354	Pittsburg. ²⁵	"	"
Philadelphia and Erie Division.			
0	Sunbury. ²⁶	11 b.	Chemung.
2	Northumberland	"	"
9	Montandon.	5 b.	Clinton.
13	Milton. ²⁷	"	"
17	Watsontown.	"	"
19	Dewart.	10.	Hamilt. & 7 Lew. l.s.
24	Montgomery.	"	"
28	Muncy. ²⁸	5 b.	Clinton.
40	Williamsport. ²⁹	10.	Hamilton.
45	Linden.	11 a.	Portage.
52	Jersey Shore. ³⁰	11 b.	Chemung.
57	Pine.	"	"
60	Wayne.	"	"
65	Lock Haven. ³¹	"	"

14. Vertical Oriskany and glass sand quarry on the opposite (east) bluff.
15. Plenty of middle Devonian fossils to the south of the town, across the flat, which was once a deep lake, now probably filled with glacial moraine matter. One mile further on, high and picturesque pulpit rocks of Oriskany crown the bluffs on both sides of the river. Best view to be got by crossing the turnpike bridge at Huntingdon and riding a mile towards Petersburg. Fine pulpit rocks stud the crest of Warrior's Ridge to the north and far to the north-east.
16. To the south are the Springfield Furnace mines. Up Spruce Creek a dozen miles are the largest Limonite mines of the interior of the State.
17. Here Potsdam comes up in the centre of the overturned anticlinal.
18. Blair's mine, between Bell's Mills and Altoona. An open quarry in limonite on Oriskany and Helderberg outcrops; very curious. Unique exposure of *celestine* in the bank of the creek below Bell's Mills.
19. Horseshoe Bend, on 1° gradient, cuts off the point of a spur of Catskill and Pocono, and makes high cliffs.
20. Coal mines and coke ovens for miles.
21. The anticlinal at the Viaduct brings the Manch Chunk Red Shale 20 feet above grade, and produces the 3 mile loop in the river. A very curious place. Notice the false bedded boulders of Pocono sand stone lying in the bed of the valley below, under the viaduct.
22. A vast bed of fire-brick clay half a mile back.
23. Notice the arch of Pocono and Catskill opposite. On the opposite mountain top lies a small patch of the lowest coal bed of the Alleghany River series.
24. Here the Pittsburg Coal Bed is first met—the lowest bed of the upper productive (Monongahela River) Coal series. Down the Loyalhanna, left bank, 6 miles, the hill slope is covered with cubic blocks of sand rock 20 feet high and 100 feet on a side, moved from their original sites.
25. The Pittsburg Coal Bed is seen mined at the hill tops south of the city, 350 feet above the Monongahela River level. At the south end of the hill behind the city, stands an oil well derrick 70 feet high, 100 feet above the streets. It has been bored to a depth of 2,300 feet, through the Butler Oil Rocks, but yields nothing but a stream of strong brine.
26. Fine cliffs opposite, west side of the river. Superb landscape from hill ½ mile back of station.
27. In the centre of a rolling plain of Clinton anticlinals and synclinals crossing the river from east to west, bounded on the west by anticlinal Oneida and Medina Mountains called the "Buffalo," "Seven Mountains," Jacks," &c., around the bases of which run the outcrops of the fossil ore.
28. Plenty of fossils; fine cliffs of Chemung and Portage facing the river on the east side. Last appearance of Silurian Mountains of Middle Pennsylvania in the progress towards the north east—the end of the Bald Eagle Mountain (5 a. Medina) close along the railroad. Facing, to the north, appears the wall of the Alleghany Mountains with patches of the lowest coal on the broken forest plateau above.
29. Five miles south, through a gap, lies the little secluded Musquito Valley of Siluro-Cambrian limestone, with black marble quarries of Utica or Trenton.
30. Gap into secluded Nippenose or Oval Valley (anticlinal S.-C. limestone; fossils), 4 miles south and across the river, has in it a remarkable conical glacial (?) hill.
31. Five miles south enter Nippenose Valley; limestone; limonite mines; Trenton fossils, &c.

Pennsylvania Railroad—Continued.		Pennsylvania Railroad—Continued.	
Ms.	Frederick Division.	Ms.	Bald Eagle Valley Division.
0	Columbia. ⁴⁶	0	Tyrone.
5	Stoner.	5	Bald Eagle. ⁵⁵
14	York. ⁴⁹	10	Hannah.
19	Graybill.	14	Port Mathilde.
25	Minges Mill.	21	Julian.
32	Hanover.	26	Unionville.
39	Littlestown.	29	Snow Shoe Jun.
47	Taneytown, Md.	31	Milesburg. ⁵⁶
70	Frederick, " 4 a. Trenton.	34	Curtin.
		40	Howard.
	Waynesboro Branch.	44	Eagleville.
0	Downingtown. 4 a. Trenton.	51	Mill Hall.
6	Brooklyn. 1. Azoic.	55	Lock Haven.
12	Barneston. "		
18	Honeybrook. "	31	Milesburg. ⁵⁶
		33	Bellefont. ⁵⁷ 4 a. Trenton.
	Williamsburg and Springfield Branch.		Tyrone and Clearfield Division.
0	Williamsburg. ⁵⁰ 4 a. Trenton.	0	Tyrone. 5 b. Clinton.
6	Reese's. 10. Hamilton.	6	Vanscoyoc. 12. Catskill.
11	Frankstown. ⁵¹ "	13	Summit. ⁵⁸ 14 a. Pottsville Conglo.
14	Holidaysburg. 5 b. Clinton.	19	Osceola. ⁵⁹ 14 b. Coal Measures.
	Ebensburg and Cresson Branch.	24	Phillipsburg.
0	Cresson. { 14 b. Coal Measures,	29	Wallaceton.
6	Kaylor's. { Allegheny River Ser.	34	Woodland.
11	Ebensburg. "	41	Clearfield.
		47	Curwinsville.
	Bedford Division.		Phillipsburg and Moshannon Branch.
	(See Huntingdon and Broad Top Railroad.)	0	Morrisdale. ⁶⁰ 14 b. Coal Measures.
0	Mount Dallas. ⁵² 5 b. Clinton.	8	Osceola.
8	Bedford. ⁵³ 7. Lower Helderberg.	13	Sterling.
13	Napier. 5 b. Clinton.	17	Ramey.
18	Sulphur Springs "		Holidaysburg and Morrison's Cove Branch.
22	Bard's. "	0	Altoona. 10. Hamilton.
31	Bridgeport. ⁵⁴ "	4	Canaan.
36	Cook's Mills. "	8	Holidaysburg. 5 b. Clinton.
39	State Line, Md. "	11	Reservoir.
41	Mt. Savage Jn. "	17	Roaring Spr's. ⁶⁰ 4 a. Trenton.
45	Cumberland, " 7. Lower Helderberg.	22	Martinsburg.
		28	Henrietta. ⁶¹ "

49. This road follows the York county belt of the Cadorus (S.-C.) limestones, with the south-east edge of the Trias, not far off on the right, and the north-west edge of the Azoic country on the left. Pigeon Hills (Azoic or perhaps Potsdam?) to the right before reaching Hanover. Trap dikes just west of Hanover; and at Littlestown.

50. The great Springfield furnace limonite mines are (by Mine Railroad) 5 miles to the south.

51. Old and extensive Clinton (fossil) ore mines here.

52. Extensive fossil ore mines at Bloody Run, east of Mount Dallas; and in the gap of the mountain approaching Bedford.

53. Mineral waters. Abundance of Helderberg and Oriskany fossils; interesting and varied geology; iron mines around.

54. At north end of, but outside of the Cumberland coal basin.

55. This and the following stations are at old iron furnaces, not able to use their fossil ore close by, and therefore hauling Sil.-Cambrian limonites from the Warrior Mark Valley, over the Bald Eagle Mountain.

56. Entrance gap to the Nittany Limestone Valley full of iron ore banks.

57. Trenton fossils abundant here. To the south-east, seven miles, Nittany Mountain, in the centre of the valley; fine views; curious geology; synclinal ships-keel mountain; turnpike road.

58. Summit of Allegheny Mountain and east edge of the bituminous coal fields. Here Powell's semi-bituminous coal mines.

59. Many coal mines along the Moshannon above and below this in the 1st subdivision of First Basin. Road gets into 2d subdivision, over a low anticlinal. All the mines along this road are on beds of the Allegheny River series.

60. Here enter Morrison's Cove by a gap in the nearly vertical Medina and Oneida rocks of Dunning's Ridge. Fossil ore outside (W.); Bloomfield limonite mines (very famous) inside (E.) U. S. cannon made at Pittsburg from pig metal made at the furnace in the gap. Sinking springs up the run.

Ms. Northern Central Railway—Continued.			Erie Railway—Continued.		
			Honesdale Branch.		
106	Halifax.	12. Catskill.	0	Lackawaxen.	12. Catskill.
111	Millersburg. ⁷⁷	13 b. Mh. Ck. Red shale.	4	Rowland's.	"
118	Mahantango.	12. Catskill.	8	Millville.	"
127	Trevorton. ⁷⁸	"	12	Kimble's.	"
133	Selinsgrove. ⁷⁹	10. Hamilt. & 7 Lew. l.s.	16	Hawley.	11 b. Chemung.
138	Sunbury. ⁸⁰	12. Cats'l or 11 b. Che'g.	20	White Mills.	"
	(Philadelphia and Erie to Williamsport.)		25	Honesdale. ⁸⁸	"
178	Williamsport. ⁸¹	10. Hamilton.	Delaware and Hudson Railroad.		
187	Cogan Valley.	12. Catskill.	0	Carbondale.	{ 14 b. Anthracite Coal Measures.
192	Trout Run. ⁸⁰	"	7	Jermyn.	"
198	Bodine's.	"	13	Dickson.	"
202	Ralston.	14 b. Coal Measures.	16	Scranton.	"
203	McIntyre. ⁸¹	"	Delaware, Lackawanna & Western R.R.		
207	Roaring Run.	12. Catskill.	0	New York.	(Cont'd from N. Jersey.)
212	Carpenter's.	11 b. Chemung.	84	Delaware.	4 c. Hudson River.
218	Canton.	"	92	Water Gap. ⁸⁴	5 a. Oneida.
220	Minnequa Sprs.	"	96	Stroudsburg. ⁸⁵	10. Hamilton.
222	Alba. ⁸²	12. Catskill.	100	Spragueville.	12. Catskill.
231	Troy.	"	104	Henryville.	11 b. Chemung.
236	Columbia X Rds	11 b. Chemung.	109	Oakland.	13 a. Pocono Sandstone.
241	Snediker's.	"	115	Forks.	"
247	State Line.	"	122	Tobyhanna.	"
256	Elmira, N. Y.	"	128	Goldsboro. ⁸⁶	"
Shamokin Division.			136	Moscow.	"
138	Sunbury. ⁸⁶	12. Catskill.	139	Dunning's. ⁸⁷	"
156	Shamokin. ¹⁸¹	{ 14 b. Anthracite Coal Measures.	149	Scranton.	{ 14 b. & c. Anthracite Coal Measures.
164	Mt Carmel. ¹⁰⁸	"	159	Abington.	12. Catskill.
Erie Railway.			164	Factoryville. ⁸⁸	"
Jefferson Branch.			174	Nicholson.	"
0	Susquehanna.	11 b. Chemung.	176	Foster.	11 b. Chemung.
11	Starrucca.	12. Catskill.	183	Montrose.	"
14	Thompson's.	"	190	New Milford.	"
25	Herrick Centre.	"	196	Great Bend.	"
33	Forest City.	13 a. Pocono.	210	Binghamton.	(Continued in N. Y.)
38	Carbondale.	{ 14 b. Anthracite Coal Measures.			

77. End of the Carlisle-Duncannon long trap dike is just back of this. See Notes 9 and 170.
 78. West end of the anthracite coal field. No anthracite west of this. Fine study of the lowest beds in the gap of the Conglomerate mountain.

79. Easternmost limit of the fossil ore outcrops of the Lewistown belt. Good anticlinal sections of 10. Genesee, Hamilton, Marcellus and 7. Lewistown l. s. between here and Sunbury.

80. Entrance to the long gorge of the Lycoming Creek through the Alleghany Mountain plateau; similarly situated to Queen's Run (32). Gorge exactly like that of the West Branch Susquehanna (33). Coal patches 1000 feet above road level, up Trout Run.

81. Old iron mines under the cliffs of Pottsville conglomerate forming the cornice of the mountain walls. Great incline plane up mountain to McIntyre coal mines.

82. The Armenia Mountain of Catskill and Pocono dominates this on the west. On its top is the east end of the Blossburg-Antrim semi-bituminous coal basin.

83. Head of the Delaware and Hudson Canal supplied with Carbonale and Scranton anthracite coal of the third great basin by railroads coming out of the basin over the Wyoming mountains.

84. Celebrated for its scenery. Large hotels. Indian staircase in the gap made by massive north dipping outcrops of Medina and Oneida. One mile before reaching these rocks are quarries of Hudson River roofing slate on both sides of the Delaware River.

85. Excellent geological headquarters. Fine exposures of Oriskany, Waterlime, &c., &c., in the ravine of Broadhead's Creek between the gap and Stroudsburg. Fossils abundant around Stroudsburg. Buttermilk and other cascades to the right of the road. (east). Noble carriage drive and exquisite scenery, for 30 miles from Stroudsburg to Milford. Lake on top of the Blue (Kittatinny) Mountain, 10 miles east of S. Fine drive southwest through Red Valley (Clinton) and over outcrops of Helderberg to the Wind Gap. Ascent of the Pocono Knob (Catskill) to the northwest.

86. Head waters of Lehigh, on the extreme highland, "shades of death," "beach woods," a plate of Pocono rocks covered here and there by synclinal outstretches of Mauch Chunk red shale.
 87. Commence descent into third anthracite coal field by a ravine through the Pottsville conglomerate. Under it the iron ore of XI. has been opened.

88. Now over the Elk Mountain range and synclinal of Pocono in the first bituminous coal basin; but no coal.

Delaware, Lackawanna & Western—Cont.			Ms. Lehigh Valley Railroad—Continued.	
Bloomsburg Division.				
0	Scranton.	{ 14 b. and c. Anth'e Coal ⁸⁹ Measures.	107	Mauch Chunk ⁹⁰
6	Lackawanna.	{ " "	114	Penn Haven.
12	Wyoming.	{ " "	120	Drake's Creek.
20	Plymouth.	{ " "	130	Tannery.
24	Nanticoke. ⁸⁹	{ " "	132	Whitehaven.
33	Schickshinny. ⁹⁰	{ " "	142	Summit Siding.
41	Beach Haven.	{ 14 a. Pottsville Conglo.	146	Fair View. ⁹¹
47	Briar Creek.	{ 11 b. Chemung.	152	Newport.
54	Espy. ⁹¹	{ 10. Hamilton.	158	Sugar Notch.
58	Rupert.	{ 8. Oriskany.	162	Wilkesbarre.
68	Danville. ⁹²	{ 11 b. Chemung.	168	Fort Blanchard.
80	Northumberla'd	{ 5 b. Clinton.	(Pa. & N. Y. R. R.)	
		{ 11 b. Chemung.	170	Pittston.
			172	L. & B. Junc'n.
			183	Falls. ¹⁰⁰
			186	McKunes. ¹⁰¹
			194	Tunkhannock.
			199	Vosburg.
			206	Mehoopany.
			209	Meshoppen.
			217	Laceyville.
			227	Wyalusing.
			233	Frenchtown.
			237	Rummerfield.
Lehigh Valley Railroad.				
0	Perth Amboy.	(See New Jersey.)		
61	Easton. ⁹³	3 a. Calciferous.		
73	Bethlehem. ⁹⁴	" "		
88	Allentown.	" "		
81	Catasauqua. ⁹⁵	4 a. Trenton.		
87	Laury's.	4 c. Hudson Riv. Shales.		
94	Slatington. ⁹⁶	" "		
103	Lehighton. ⁹⁷	11 b. Chemung.		

89. River breaks out of coal field under cliffs of Pottsville conglomerate and runs in Mauch Chunk red shale.

90. River cuts across the coal field, leaving a small mound of coal measures isolated on the west bank.

91. Square across to the north, 6 miles, is seen the high end of the Schickshinny (Pocono) Mountain, reached by a good road from Bloomsburg, 7 miles, and affording one of the finest panoramic views in Pennsylvania.

92. Famous and extensive fossil ore (Clinton) iron mines, sunk deep. Iron works here and at Bloomsburg. Ore crops along both sides of mountain ridge for 15 miles. May be studied on the anticlinal arch in the gaps at both places. See also Note 134.

93. Famous collecting ground for rare minerals. Azoid ridge to the north. Remarkable outcrops, natural and artificial, of the calciferous limestones along the river north bank to Bethlehem. Many iron works. Laurentian rocks south of the river all the way up.

94. Zinc works. Saucon zinc mine in the mountains to the south, easily reached by N. P. Railroad.

95. Perhaps the best limonite open mine in America for study, lies 4 miles west, (Ironton). Best reached on wheels; also by rail, over a long, high iron bridge. Manganese, kaolin, lignite, with the ore. Mine very large and old.

96. Extensive roofing slate quarries here. Two miles further enter the Lehigh Water Gap between sloping walls of Oneida and Medina. Issue upon Clinton red shale. Notice a fine Eddy Hill opposite. Behind it is a terminal moraine, which a glacier, formerly descending the Lehigh, left across the mouth of the Aquashicola Creek, forcing that stream to excavate a new channel in the solid Medina rocks of the mountain. Two miles farther, at the bend of the river, north bank, the ice has crushed over the slates, polished the surface, and loaded it with till. From the Gap Hotel ride to the top of Stone Hill (Oriskany outcrop) for the view through the gap. Hydraulic lime quarries on the way up.

97. On the crest of one of the grandest anticlinals in the state. The gently south dipping Chemung and Hamilton here turn over and descend vertically. From here to Mauch Chunk the Devonian and Bernician systems are complete, vertical, and crossed at right angles, so as to give an easy section of 10,000 feet, up to the coal measures.

98. Fine geological headquarters. The gap in the second mountain gives the whole Pocono and Catskill. The river above gives the Mauch Chunk red shale. Mt. Pisgah, the Pottsville conglomerate. Nine miles up the "passenger tourist's gravity road" lies the famous Summit Mine, mammoth coal bed, 60 feet thick, open quarry. In the gap notice the ialet on which the first anthracite iron furnace once stood. Good specimens of dendrites to be got from the plates in the mountain opposite the hotel. From here to Penn Haven, the fine gorge of the Lehigh with its ox bow bend and walls of Catskill rocks.

99. Ascend 400 feet higher to the summit of Penobscot Knob, affording the finest view in the state. Notice the glacial scratches on the rock on the highest summit of the knob. From here all the collieries are visible below, and the whole structure of the third anthracite coal basin can be made out. Down Solomon's gap by three old incline planes, notice the erosion of the red shale.

100. Buttermilk Falls, not the falls of that name near Stroudsburg, but in nearly the same rocks, with the hollows filled with gravel.

101. Enter the long gorge of the north branch of the Susquehanna through the Allegheny mountain plateau, capped (further west) by the Mehoopany coal basin.

Lehigh Valley Railroad. (Pa. & N. Y. R. R.)—Continued.		Danville, Hazleton & Wilkesbarre Railroad.	
Ms.		0 Sunbury. ⁹⁸	12 Catskill.
244 Wysauking. ¹⁰⁸	11 b. Chemung.	11 Danville. ¹⁸⁴	5 b. Clinton.
248 Towanda. ¹⁰⁸	"	20 Catawissa.	11 b. Chemung.
255 Ulster.	"	54 Conyngham.	"
259 Milan.	"	Cranberry.	14 b. Anth. Coal Mrs.
263 Athens.	"	Hazleton. ¹⁰⁴	"
265 Sayre.	"		
268 Waverly, N. Y.	"		
Mahanoy, Beaver Meadow & Hazleton Branch.		Montrose Railroad.	
54 Penn Haven Ju.	13 b. Mauch Chk. r. s.	0 Montrose.	11 b. Chemung.
60 Weatherby.	14 b. Anth. Coal Mrs.	8 Hunter's.	12. Catskill.
70 Eckley.	"	14 Springville.	"
70 Hazleton. ¹⁰⁴	"	22 Lobeck.	"
66 Beaver Meadow.	"	28 Tunkhannock.	"
70 Audenried.	"		
Barclay Railroad.		Central Railroad of New Jersey.	
59 Black Creek Ju.	"	75 Easton. ⁹⁸	3 a. Calciferous.
66 Hartz's.	"	86 Bethlehem. ⁹⁴	"
71 Switch Back.	"	95 Catasauqua. ⁹⁵	4 a. Trenton.
78 Quakake Junct.	13 b. Mauch Chunk.	109 Lehigh Gap. ⁹⁸	11 b. Chemung.
81 Mahanoy.	14 b. & c. Coal Measures.	120 Mauch Chk. ⁹⁸	13 b. Mauch Chunk r. s.
84 Shenandoah.	"	127 Penn Haven Ju.	"
89 Raven Run.	"	145 White Haven.	12. Catskill.
93 Centralia.	"	158 Penobscot. ⁹⁹	"
100 Mt. Carmel. ¹⁰⁵	"	171 Ashley.	14 b. Anth'e Coal Mrs.
		174 Wilkesbarre.	"
		183 Pittston.	"
		187 Spring Brook.	"
		193 Scranton.	"
		195 Green Ridge.	"
State Line and Sullivan Railroad.			Wilmington & Lackawanna Valleys and coal field.
0 Towanda. ¹⁰⁸	11 b. Chemung.		
7 Greenwood.	12. Catskill.		
16 Barclay. ¹⁰⁸	14 b. Coal Measures.		
Mancy Creek Railway.		Philadelphia and Reading Railroad.	
0 Towanda. ¹⁰⁸	11 b. Chemung.	0 Philadelphia.	1. Azoic.
4 Monroeton.	"	4 Belmont.	"
24 Dushore.	12. Catskill.	8 W. Manay'k. ¹⁰⁷	"
29 Bernice.	{ 14 b. Loyalsock Coal Measures, semi- Anthracite.	14 W. Consho'n. ¹⁰⁸	"
		17 Bridgeport. ¹⁰⁹	3 a. Calciferous.?
		22 Port Kennedy.	2 b. Potsdam.
		24 Valley Forge. ¹¹⁰	"
		28 Phoenixville. ¹¹¹	16. Triassic.
		32 Royer's Ford.	"
		40 Pottstown. ¹¹²	"

102. A remarkable fault in the 11 b. Chemung rocks in the Wysox Narrows. It slants up the hill-side and may be studied on the R. R. and on the common road 200 feet above. The centre line of the Towanda anticlinal crosses the river at the northern end of this cliff, 1,050 feet above the fault.

103. Fine cliffs, "The Red Rocks," just north of the fault and east from Wysauking station. Chemung fossils. Also another cliff directly opposite Towanda on east side of the river. Going north no such precipices are seen, the Chemung shales forming hills with rounded summits. Good view of Towanda village from the railroad. Boulders of white limestone from Central New York found in the river were formerly burnt for lime. Picturesque view at Ulster Narrows.

104. Mammoth and other anthracite beds mined extensively along this road.

105. In the centre of the Shamokin group of 3 anthracite sub-basins.

106. Barclay or Towanda C. Co.'s and Schroeder Mines on the top of the Towanda Mountain, 1,800 feet above the river at Towanda. Incline plane. High falls. Profound gorges splitting the mountain. Laurel swamps. Semi-bituminous coal.

107. Beautiful ravine of the Wissahiccon to the east, deeply trenching the Azoic belt. Serpentine and soapstone quarries 2 miles above Manyunk.

108. Trap, marble, near.

109. On south edge of the Trias country. Bone cavern in limestone quarry near Port Kennedy studied by Dr. Leidy and Prof. Cope.

110. Ditto. The hill back of it is the east end of the ridge of Potsdam sandstone forming the north wall of the Chester Valley far to the southwest. Under its north flank come up the Azoic.

111. In the tunnel here Mr. Wheatley found his coal plants (Trias) and reptile bones. Two miles southwest runs the edge of the Trias, with breccias, copper veins, on Azoic. Trias continues hence to near Reading. Mr. Wheatley has his collection here.

112. Trap hills to the north.

Ms. | Philadelphia and Reading R.R.—Con.

45 Douglasville.	15 b. Triassic.
47 Monocacy.	"
52 Exeter. ¹¹⁸	"
58 Reading. ¹¹⁴	3 a. Calciferous.
66 Leesport. ¹¹⁴	4 b. Utica.?
70 Shoemaker'sville	4 c. Hudson River s. l.
75 Hazaburg.	"
78 Pt. Clinton. ¹¹⁵	5 b. Clinton.
83 Auburn. ¹¹⁶	7. Lower Helderberg.
86 Landingville.	11 b. Chemung.
88 Pottsville. ¹¹⁷	14 b. & c. An. Cl. Mres.

Lebanon Valley Branch.

0 Allentown. ¹¹⁸	3 a. Calciferous.
6 Emaus.	"
10 Millerstown.	"
15 Shamrock.	"
18 Topton.	"
25 Fleetwood.	"
31 Temple.	"
36 Reading. ¹¹⁴	"
45 Wernersville.	"
51 Womelsdorf.	"
58 Myerstown.	"
64 Lebanon. ¹¹⁹	"
69 Annville.	"
74 Palmyra.	"
81 Hummelston. ¹²⁰	"
90 Harrisburg.	4 b. Utica Slate.

Little Schuylkill, East Mahanoy, Mine Hill and Mahanoy & Shamokin Branches.

0 Herndon.	12. Catskill.
14 Trevorton.	14 b. & c. An. Cl. Mres.
21 Shamokin. ¹²¹	"
25 Excelsior.	"
30 Mount Carmel.	"
43 Ashland. ¹²²	"
45 Girardville.	"
47 Mahanoy. ¹²³	"
98 Tamaqua. ¹²⁴	"
102 Ringgold. ¹²⁵	5 b. Clinton.

Ms. | Philadelphia and Reading R. R.—Con.

Chester Valley Branch.

0 Bridgeport.	3 a. Calciferous.
6 Centerville.	"
10 Cedar Hollow.	"
16 Exton.	"
22 Downingtown.	"

Schuylkill and Susquehanna Branch.

0 Auburn. ¹¹⁶	9. Upper Helderberg.
5 Hannon.	10. Hamilton.
12 Rock.	"
18 Pine Grove.	11 b. Chemung.
24 Ellwood.	13 b. Mauch Chu'k r.s.
30 Rausch Gap.	"
35 Yellow Spring.	"
38 Rattling Run.	"
46 Forge.	"
51 Dauphin.	"
54 Rockville. ⁸	4 c. Hudson River Slate.
59 Harrisburg.	4 b. Utica Slate.

Schuylkill Valley Branch.

0 Pottsville. ¹¹⁷	14 b. & c. An. Cl. Mres.
4 Port Carbon.	"
7 New Philadel'a.	"
18 Tuscarora.	"
18 Tamaqua. ¹²⁴	"

Pickering Valley Branch.

0 Phoenixville. ¹¹¹	16. Triassic.
11 Byers.	1. Azoic.

Reading and Columbia Branch.

0 Reading. ¹¹⁴	3 a. Calciferous.
6 Sinking Springs	"
13 Reinholds.	16. Triassic.
16 Union. ¹²⁶	"
20 Ephrata.	3 a. Calciferous.
27 Litiz.	"
32 Manheim.	"
37 Landisville. ⁵	"
41 Ironville. ¹²⁷	2 b. Potsdam.
46 Columbia. ⁴⁶	3 a. Calciferous.

113. Trap dikes to the south and west, across the river.
 114. The "White Spot" high on the mountain to the east is supposed to be a remnant of Potsdam sandstone left lying unconformably on Laurentian.

115. A noble fault crosses the river three times in the gap; once at the canal locks, again at the rock at the west mouth of the old tunnel and then runs vertically up the steep. Hudson River slates dipping 10° south abut against the bottom plate of Onelda standing vertically. Between this and Auburn very fine exposures of Clinton red shales. No fossil ore.

116. Back of this on the south side of Summer Hill, multitudes of Hamilton and Portage fossils.

117. Centre of the soft anthracite collieries. Fine geological headquarters. For four miles before reaching this place the whole Devonian and Bernician systems stand vertical, affording a section of 20,000 feet of rock, up to the top of the lower productive coal series in the fold of the great synclinal in the lower part of the town. View from the top of Sharp Mountain, 800 feet high, instructive. Hotel at Mount Carbon close to where Lea's footprint was found.

118. Road runs along the base of the Laurentian Mountains, over calciferous, holding limonite beds.

119. Cornwall Magnetic Iron Mines 6 miles to the south; holds copper, trap and marble.

120. Iron mines, limonite, south of the town.

121. In the gap opposite the town five ribs of Pottsville conglomerate enclose the four lowest anthracite coal beds. A cross section of the coal measures up to the 12th bed can be made here.

122. Remarkable large fossil tree stems visible in the coal measures here. Glacial strata cross white pebbles in the conglomerate crest of mountain west of the Ashland Gap, opposite Mt. Carmel.

123. Large collieries. Shaft sunk by diamond drill.

124. Little Schuylkill here makes a cross section of the Pottsville coal basin.

125. From here down to Port Clinton the Little Schuylkill cuts through ten anticlinals.

126. All along here the thinness of the Trias upon the Cambro-Silurian is revealed by erosion.

127. Famous old limonite mine.

Ms. Philadelphia and Reading R. R.—Con.		Philadelphia and Reading Railroad—Con.	
Lancaster and Quarryville Branch.		Ms. Mill Creek and Mount Carbon Branch.	
0 Lancaster Jun.	3 a. Calciferous.	0 Pottsville. ¹¹⁷	14 b. Anth. Coal Mres.
8 Lancaster.	"	4 Dormer's.	"
14 West Willow.	"	7 New Castle.	"
20 New Providence	1. Azoic.	12 Frackville.	"
23 Quarryville.	"	Colebrookdale Branch.	
Lebanon and Tremont Branch.		0 Pottstown. ¹¹⁸	16. Triassic.
13 Tremont. ¹²⁸	14 b. Coal Measures.	6 Colebrookdale.	1. Azoic.
20 Pine Grove.	11 b. Chemung.	13 Mt. Pleasant.	"
24 Irving.	10. Hamilton.	Philadelphia and Chester Branch.	
29 Murray. ¹²⁹	"	0 Eddystone.	1. Azoic.
37 Jonestown.	4 c. Hudson River.	4 Thurlow.	"
44 Lebanon. ¹¹⁹	3 a. Calciferous.	Germantown and Norristown Branch.	
Mine Hill and Schuylkill Haven Branch.		7 Germantown.	1. Azoic.
0 Schuylkill Hav.	11 b. Chemung.	16 Norristown.	16. Triassic.
9 Minersville. ¹²⁰	14 b. and c. Coal Mres.	Chestnut Hill Branch.	
14 Glen Dower.	"	0 Philadelphia.	1. Azoic.
Catawissa and Williamsport Branch.		11 Chestnut Hill.	"
0 Philadelphia.	(See main line.)	South Mountain Branch.	
78 Port Clinton. ¹¹⁸	5 b. Clinton.	0 Carlisle Junct'n.	4 a. Trenton.
98 Tamaqua. ¹²⁴	14 b. and c. Coal Mres.	8 Upper Mill. ¹²⁵	1. Azoic.
107 Tamanend.	13 b. Mt. Ck. r.s. & s.s.	15 Laurel.	3 a. Calciferous.
114 Girard.	"	18 Pine Grove. ¹²⁶	"
118 Brand'nville. ¹²¹	13 b. Mauch Chunk red	Berks and Lehigh Branch.	
124 Ringtown.	" [shale.]	0 Reading. ¹¹⁴	3 a. Calciferous.
132 Beaver Valley.	"	43 Slatington. ¹²⁷	4 c. Hudson River s. l.
136 McAuley. ¹²²	"	Perkiomen Branch.	
139 Mainville. ¹²³	"	0 Perkiomen.	16. Triassic.
146 Catawissa.	11 b. Chemung.	6 Collegeville.	"
154 Danville. ¹²⁴	5 b. Clinton.	11 Schwenksville.	"
162 Mooresburg.	10. Hamilton.	14 Salford.	"
167 Pottsgrove.	"	18 Green Lane.	"
170 Milton. ²⁷	5 b. Clinton.	22 Hanover.	"
176 White Deer.	"	43 Allentown. ¹¹⁸	3 a. Calciferous.
182 Montgomery.	11 a. Portage.		
187 Muncy. ²⁸	5 b. Clinton.		
190 Hall's.	7. Lower Helderberg.		
195 Montoursville.	10. Hamilton.		
199 Williamsport. ²⁹	11 a. Portage.		

128. View from the mountain to the southwest of it down the fish tail double red shale valley, split by the great mass of the Pocono rocks, is fine and instructive.

129. Passing out of the gap Hole Mountain stands on the left (east) a curious synclinal outlier of Oneida capping a ridge of Hudson River, proving that no nonconformability exists.

130. A line of great collieries on the mammoth vein extend westward. The gap of the west branch Schuylkill above Minersville, shows a superb arch of the conglomerate.

131. Making down grade from the conglomerate along the southern and western sides of the red shale valley of the Catawissa Creek crossed by numerous anticlinals from between the Beaver Meadow, Hazleton and Black Creek basins, to the east, and crenulating the (Pocono) Catawissa Mountain to the west.

132. A curious little oval mountain basin of anthracite lower coal beds (McCauley) stands out on the red shale plain to the right. Notice the rift in its southern side and its fortress like outline.

133. Fine gap through the Nescopeck Mountain and section of white Pocono rocks with terraces of Red Catskill on its northern flank.

134. Fossil ore mines and Medina arch in the gap through Montour's Ridge. Fine cliffs of Portage and Chemung along the river. Also see Note 92.

135. Passes into the Papertown gap of the South Mountains and turns to the right (S. W.), up the Mountain Creek Valley, with its range of old and extensive limonite mines, open quarries; ore heavily charged with manganese. Ride to the left (E.) over the divide, on which is Strickler's mine, and down to the big bank. Very instructive. Over Strickler's, the mountain top is saddled with a 30 foot plate of Potsdam (?)

136. Extensive, well arranged limonite mine, planned by J. W. Harden.

137. Principal roofing slate quarries of the State. (See Note 96.)

North Pennsylvania Railroad.			Peachbottom Railroad.		
Ms.			Ms.		
0 Philadelphia.	1. Azoic.		0 Oxford.	1. Azoic.	
10 Abington.	"		20 Dorsey ¹⁴²	"	
14 Ft. Washington.	16. Triassic.		Corning, Cowanesque and Antrim Railroad.		
18 Gwynedd. ¹³⁸	"		0 Corning.	11 b. Chemung.	
22 Lansdale.	"		15 Lawrenceville.	"	
25 Hatfield.	"		23 Tioga.	"	
31 Sellersville.	"		39 Wellsboro.	"	
38 Quakertown.	"		51 Antrim.	{ 14 b. Semi-Bitumin's Coal Measures.	
44 Coopersburg ¹³⁹	"		15 Lawrenceville.	11 b. Chemung.	
51 Hellertown.	3 a. Calciferous.		27 Elkland.	"	
54 Bethlehem. ⁹⁴	"		Tioga Railroad.		
New York & Philadelphia R.R. (New Line.)			0 Corning.	(See C. C. & A. R. R.)	
Delaware and Boundbrook.			15 Lawrenceville.	"	
0 Philadelphia.	1. Azoic.		23 Tioga.	11 b. Chemung.	
8 Jenkintown.	"		31 Mansfield.	" Iron ore.	
15 Somerton.	"		36 Covington.	"	
21 Langhorne.	16. Triassic.		41 Blossburg.	{ 14 b. Semi-Bitumin's Coal Measures.	
29 Yardley.	"		F. B. C. Co. R. R.		
88 Jersey City.	(See New Jersey.)		48 Fall Brook.	"	
Wilmington and Northern Railroad.			41 Blossburg.	"	
0 Reading. ¹¹⁴	3 a. Calciferous.		45 Morris Run.	"	
9 Birdsboro.	16. Triassic.		41 Blossburg.	"	
21 Springfield. ¹⁴⁰	1. Azoic.		45 Arnot.	"	
27 Waynesburg Ju	"		Buffalo, New York & Philadelphia Railroad.		
35 Brandywine.	"		0 Buffalo.	(See New York.)	
39 Coatesville.	4 a. Trenton.		78 State Line.	11 b. Chemung.	
45 Laurel Iron Wks	1. Azoic.		88 Larrabees.	"	
57 Chadd's Ford.	"		96 Port Allegany.	"	
72 Wilmington, Del	(See Del. and Md.)		107 Keating.	"	
West Chester and Philadelphia Railroad.			114 Shippin.	"	
0 West Philadel'a	1. Azoic.		121 Emporium. ⁸⁸	"	
7 Clifton.	"		Buffalo and McKean Railroad.		
14 Media.	"		0 Larrabees.	11 b. Chemung.	
18 Lenzi.	"		9 Smethport.	"	
27 West Chester.	"		15 Colegrove.	12. Catskill.	
Philadelphia and Baltimore Central R.R.			22 Clermont. ¹⁴³	14 b. Coal Measures.	
0 Philadelphia.	1. Azoic.		Buffalo, Bradford & Pittsburg Railroad.		
14 Lamokin Junc.	"		0 Carrolton, N.Y.	(See Erie Railway.)	
20 Rockdale.	"		11 Bradford. ¹⁴⁴	11 b. Chemung.	
25 Concord.	"		19 Big Shanty.	"	
33 Fairville.	"		26 Gilesville.	14 b. Coal Measures.	
40 Avondale.	"				
46 Penn. ¹⁴¹	"				
52 Oxford.	"				
112 Baltimore.	(See Maryland.)				

138. Plants in the Trias as at Phoenixville. Trap.

139. Sancon zinc mines.

140. Warwick iron mine 3 miles to the east, on the edge of Trias; with trap; copper, &c. Jones' mine $1\frac{1}{2}$ miles to the north at the east extremity of the Canestoga belt of the Lancaster Co. limestone. French Creek copper mines further east than Warwick.

141. Line of serpentine to the left. Road runs along the belt from Kennet Square for several miles.

142. Roofing slate quarries at Peach Bottom on the Susquehanna River.

143. Coal mines on the highest land at the only practicable north and south pass over the great water shed between the Pennsylvania and New York waters.

144. Latest discoveries and geologically the lowest of the Pennsylvania oil horizons; hundreds of new oil wells, all productive. Oil 1775 feet below the Oil-City-Olean conglomerate.

Dunkirk, Allegheny Valley & Pittsburg R.R.		Ms.	Erie and Pittsburg Railroad.	
0 Dunkirk.	(See New York.)	0	Erie. ¹⁴⁸	11 a. Portage.
47 Russellsburg.	11 b. Chemung.	11	Fairview.	"
55 Warren. ⁴²	"	15	Girard.	"
61 Irvineton.	"	20	Crosses.	11 b. Chemung.
67 Pittsfield.	"	26	Albion.	"
71 Garland. ⁴³	"	35	Conneautville.	"
79 Newton.	"	39	Summit.	"
90 Titusville. ¹⁴⁵	"	43	Linesville.	"
		47	Espyville.	"
		56	Jamestown.	"
		63	Greenville.	"
		71	Clarksville.	"
		77	Sharon. ¹⁴⁹	14 b. Coal Measures.
		83	Middlesex.	"
		87	Pulaski.	"
		94	Harbor Bridge.	"
		98	New Castle. ¹⁵⁰	"
Pittsburg, Titusville and Buffalo Railroad.		Lake Shore and Michigan Southern R.R.		
0 Irvineton.	11 b. Chemung.	436	Girard.	11 a. Portage.
9 Thompson.	"	441	Fairview.	"
15 Tidioute. ¹⁴⁶	"	451	Erie.	"
23 Hickory.	"	459	Harbor Creek.	"
30 Tionesta.	"	466	North East.	"
41 Oleopolis.	"	(Continued in Ohio.)		
50 Oil City.	"	Franklin Division.		
54 Rouseville.	"	36	Jamestown.	11 b. Chemung.
57 Petroleum Cen.	"	45	Salem.	14 b. Coal Measures.
68 Titusville. ¹⁴⁵	"	52	Clark.	"
79 Centreville.	"	57	Stoneboro.	"
86 Spartansburg.	"	65	Raymilton.	"
95 Corry. ⁴⁴	"	71	Summit.	"
Oil City and Ridgeway Railroad.		78	Franklin. ¹⁴⁷	11 b. Chemung.
Oil City.	11 b. Chemung.	86	Oil City.	"
Sidney's.	14 b. Coal Measures.	Shenango and Allegheny Railroad.		
Atlantic and Great Western Railroad.		0	Greenville.	11 b. Chemung.
0 Salamanca.	(See New York.)	6	North Hamburg	14 b. Coal Measures.
61 Corry. ⁴⁴	11 b. Chemung.	12	Cool Spring.	"
72 Union City.	"	17	Mercer.	"
79 Mill Village.	"	33	Harrisville.	"
88 Cambridge.	"	35	Centreville.	"
92 Venango.	"	43	Armandale.	"
96 Seagertown.	"	47	Hilliard.	"
102 Meadville.	"	Allegheny Valley Railroad.		
110 Geneva.	"	0	Pittsburg. ⁴⁵	14 b. & c. Bar. Cl. Mrs.
116 Evansburg.	"	4	Sharpsburg.	"
121 Atlantic.	"	10	Verona.	"
129 Greenville.	"	17	Parnassus.	"
131 Shenango.	"	21	Tarentum.	14 b. Lower Coal Mrs.
135 Transfer.	"	29	West Pa. Junct.	"
(Continued in Ohio.)		35	Kelly's.	"
Franklin Branch.				
0 Meadville.	11 b. Chemung.			
6 Shaw's.	"			
11 Cochranston.	"			
19 Utica.	"			
28 Franklin. ¹⁴⁷	"			
36 Oil City.	"			

145. Here is the deepest of all oil wells, but unproductive.

146. The valley of the Allegheny River is full of derricks from here to Oil City; and the valley of Oil Creek up to Titusville.

147. Lubricating oil from the first oil sand.

148. Numerous gas wells used for lighting the city, heating, rolling iron, &c.

149. Commencement of the importance of the Sharon bed as a "block coal" raw fuel for iron furnaces. It becomes the great bed of Ohio.

150. Old iron making centre. Banks of the river faced with terraces of ferriferous limestone supporting large deposits of limonite ("buhr stone") iron ore, of the lower productive coal series.

Ms. Allegheny Valley Railroad—Continued.		Pittsburg, Fort Wayne and Chicago Railway.	
44 Kittanning. ¹⁵¹	14 b. Lower Coal Mres.	0 Pittsburg. ²⁵	14 b. & c. Bar. Cl. Mres.
48 Cowanesha'ock.	"	13 Sewickly.	"
55 Mahoning.	14 a. Pottsville Conglo.	21 Baden.	"
64 Red Bank. ¹⁵²	"	26 Rochester.	14 b. Lower Coal Mres.
68 Brady's B'nd. ¹⁵³	"	29 New Brighton.	"
71 Catfish.	14 b. Lower Coal Mres.	35 Homewood. ¹⁵⁶	"
82 Parker's. ¹⁵⁴	14 a. Pottsville Conglo.	46 Enon.	"
89 Emlenton.	"	(Continued in Ohio.)	
106 Scrubgrass.	"	Pittsburg, Youngstown & Ashtabula R. R.	
115 Foster.	11 b. Chemung.	0 Pittsburg. ²⁵	14 b. & c. Bar. Cl. Mres.
123 Franklin. ¹⁴⁷	"	47 Lawrence Junc.	14 b. Lower Coal Mres.
132 Oil City.	"	57 Lowell.	"
149 Titusville. ¹⁴⁵	"	(Continued in Ohio.)	
188 Corry. ⁴⁴	"	Cleveland and Pittsburg Railroad.	
Low Grade Division.		0 Pittsburg. ²⁵	14 b. & c. Bar. Cl. Mres.
0 Red Bank. ¹⁵²	14 b. Coal Measures.	26 Rochester.	14 b. Lower Coal Mres.
15 Leathwood.	"	34 Industry.	"
20 New Bethlehem.	"	40 Smith's Fry. ¹⁵⁷	"
40 Brookville.	"	(Continued in Ohio.)	
55 Reynoldsville.	"	Pittsburg, Cincinnati & St. Louis Railroad.	
70 West Summit.	"	0 Pittsburg. ²⁵	14 b. & c. Bar. Cl. Mres.
77 Pennfield.	"	8 Mansfield.	14 c. Upper Coal Mres.
87 Tyler's.	"	15 Noblestown.	"
98 Grant.	12. Catskill.	23 Bulger. ¹⁵⁸	"
110 Driftwood.	"	32 Hanlin's.	"
Union and Titusville Branch.		(Continued in Ohio.)	
0 Titusville. ¹⁴⁵	11 b. Chemung.	Chartiers Railroad.	
8 Tryonville.	"	0 Pittsburg. ²⁵	14 c. Upper Coal Mres.
16 Lincolnville.	"	8 Mansfield.	"
25 Union City.	"	22 Canonsburg.	14 c. Up. Barren Mres.
Plum Creek Branch.		31 Washington.	"
0 Pittsburg. ²⁵	14 b. & c. Bar. Cl. Mres.	Pittsburg, Virginia & Charleston Railroad.	
12 Ink Works.	14 b. Lower Coal Mres.	0 Pittsburg. ²⁵	14 b. & c. Bar. Cl. Mres.
17 Coal Works.	"	15 McKeysport. ¹⁵⁹	14 c. Upper Coal Mres.
Sligo Branch.		32 Mo'gahela City.	"
0 Sligo Junction.	14 b. Lower Coal Mres.	55 Brownsville.	"
10 Sligo. ¹⁵⁵	"		
New Castle and Franklin Railroad.			
0 New Castle. ¹⁵⁰	14 b. Lower Coal Mres.		
9 Wilmington.	"		
16 Leesburg.	"		
22 Mercer.	"		
30 Garvin's.	"		
36 Stoneboro.	"		
57 Franklin. ¹⁴⁷	"		

151. The two Kittanning coal beds in the river hills low down; the two Freeport coal beds high up. These constitute the chief beds of the Lower Coal Measures.

152. Between the mouth of the Mahoning and the mouth of the Redbank, crosses the last of the great anticlinals, bringing up the conglomerate 100 feet above water level. It sinks 500 feet in 40 miles before reaching and crossing the Ohio River 4 miles below Pittsburg.

153. Great iron works and iron and coal mines. Wells strike oil here 1,100 feet beneath the river bed in the third oil sand of the Venango-Butler oil group.

154. High cliffs of conglomerate back of the town. A forest of oil well derricks on both river banks and on top of the cliffs. Here the Butler Co. oil belt crosses the river into Clarion County. Oil wells numerous at intervals all the way up to Franklin and Oil City.

155. Deep old oil wells. Very old iron furnace, centre of a former group of 50 charcoal blast furnaces.

156. Immense sand stone cliffs (at the base of the coal measures) wall in the valley of the Beaver. Homewood Furnace. Ferriferous limestone and ore all around.

157. Numerous old oil wells producing a little from the conglomerate and sandrocks below.

158. Prof. Stevenson's "Bulger anticlinal" crosses here. The Pittsburg coal bed is dwindling through this high upcountry to a small bed in Ohio.

Baltimore and Ohio Railroad.		Wheeling, Pittsburg and Baltimore R. R.	
Ms.	Pittsburg Division.		
0	Pittsburg. ²⁵	0	Wheeling, W. Va. 14 c. Coal Measures.
11	Port Perry. ¹⁵⁹	16	W. Alexander. "
15	McKeysport.	25	Taylorstown. "
22	Coultersville.	32	Washington. 14 c. Up. Barren Mrs.
33	West Newton.	Cumberland Valley Railroad.	
40	Jacob's Creek.	0	Harrisburg.
49	Oakdale.	8	Mechanicsburg.
57	Connellsville. ¹⁶⁰	19	Carlisle. ¹⁷⁰
65	Indian Creek. ¹⁶¹	30	Newville.
74	Ohio Pyle. ¹⁶²	41	Shippensb'g. ¹⁷¹
84	Confluence. ¹⁶³	52	Chambers'g. ¹⁷²
92	Pinkerton. ¹⁶⁴	63	Greencastle.
101	Mineral Pt. ¹⁶⁵	74	Hagerstown, Md.
109	Yoder's.	94	Martinsburg. (See Maryland.)
116	Sand Patch. ¹⁶⁶	Hanover Junction, Hanover and Gettysburg Railroad.	
126	Glencoe.	0	Gettysburg. ¹⁷³
135	Bridgeport. ⁵⁴	4	Granite.
141	Cook's Mills.	5	Gulden's.
146	Mt. Savage Jun.	10	Oxford.
150	Cumberland, Md.	13	Valley. ⁴⁹
Huntingdon and Broad Top Railroad.		17	Hanover.
0	Huntingdon. ¹⁶	20	Smith's.
7	Grafton.	22	Porter's.
15	Coffee Run.	26	Jefferson.
24	Saxton. ¹⁶⁷	27	Cold Spring.
31	Hopewell. ¹⁶⁸	28	Strickhauser's.
43	Bloody Run. ¹⁶⁹	30	Hanover Jun. ⁷²
53	Bedford. ⁵³		

159. Mines in the Pittsburg coal bed line the river on both sides in a continuous series; the bed descending slowly from 360 feet above water level at Pittsburg to within 30 or 40 feet in the neighborhood of Monongahela City. The bed rises again and goes into the air ascending the Youghiogheny River; the banks becoming hillslopes of the barren measures.

160. Pittsburg bed 13 feet thick in this narrow basin.

161. Fine gorge of the Youghiogheny through Chestnut Ridge, walls 1,300 feet high. Pulpit rocks of Piedmont sandstone (top member of Pottsville conglomerate) left standing like stranded ships on the broad summit of the mountain. Dry oil wells and old salt wells in the floor of the gorge on the river bank. Cow rock on the southern brow of the gorge covered with the sculptures of the aborigines.

162. Fine Cascade. The whole river falls over a horizontal plate of coal measure sandstone. Wild scenery all around. Coal bed 4 feet thick under the falls.

163. The Turkey Foot. Junction of the three great branches of the Youghiogheny. Very remarkable oval hill of coal measures terraced by coal bed outcrops all around, as if artificially, several hundred feet high. Flat top, a field from which Indian skeletons have been ploughed up ever since the first settlement of the country, called Fort Hill.

164. Fine mountain nose full of coal beds and terraced by sandstone of the barren measures.

165. The fine isolated Pittsburg coal bed basin of the Salisbury Ridge, to the south, capped with fossiliferous limestones of the upper coal measures. Romantic falls on Elk Lick Creek not far up from its mouth.

166. Summit of the Alleghany Mountain.

167. Turn in here to the Broad Top Coal Mines up Shoup's Run. Hotel at Broad Top City, as high as the top of the Alleghany Mountain. Fine scenery. Curious geology.

168. Juniata flows in the red shale under cliffs of conglomerate on one side and a Pocono sandstone (terrace) mountain on the other. Iron works. Fine section up Yellow Creek into Morrison's Cove. Great crop of Hamilton limonite.

169. Long outcrop of Clinton fossil ore. Beautiful turnpike carriage drive, south, along the river, and over Wray's Hill, with wonderful sections of contorted Catskill all the way.

170. Trap dyke, 3 miles before reaching Carlisle; visible a long way off as a low mound across the great valley covered with trees, while all around is cultivation. West of Carlisle notice "Wagner's Gap" and "Doubling Gap" in the North or Blue Mountain. They are really not gaps but folds, caused by anticlinals passing through the mountain and elevating the vertical 5 a. Medina strata. The mode in which this was done may be understood by holding up the edge of a sheet of paper in a perpendicular manner and then elevating it in one spot from beneath, which will cause the upper edge to fold in an S shape, similar to these so-called gaps.

171. Five miles due east is a great spring rising at the south end of the limestone, and foot of the mountain; the head of Yellow Breeches Creek.

172. Back set of the mountains to the east and cross fault along the turnpike to Gettysburg. A mile or so south of the turnpike immense old limonite ore banks (Pond Bank, &c.) in which kaolin and lignite deposits occur like those of Brandon in Vermont. Five miles further south in the foot of the mountain are the Mont Alto ore banks. Back of Mont Alto in the mountains are magnetic ore beds, porphyry rocks, copper ores.

Ms. East Broad Top Railroad. ¹⁷⁴		Ms. East Broad Top Railroad—Continued.	
	5 a. Medina. 8. Oriskany. 10 a. Marcellus. 10 b. Hamilton. Oriskany Ridge on east. Hamilton on w.		18 b. Mh. Ck. r. s. E. " tunnel. 14 a. & 14 b. on west. 13 b. Mauch Ck. r. s. 14 a. Conglomerate. 14 b. Lower Coal Series.
0 Mt. Union. ¹⁷⁵		25 Coles.	
4 Aughwich.		28 Cook's.	
7 Shirley.	10 a. Marcellus.	31 Robertsdale. ¹⁷⁷	
11 Rockhill. ¹⁷⁶	"	Philadelphia, Wilmington and Baltimore Railroad.	
14 Beersville.	11 a. Portage. 11 b. Chemung. 10 a. Marcellus. 8. Oriskany, cut. 7 L. Helderberg l. s. 5 b. Clinton anticlin. 6. Salina & waterlime. 7. L. Helderberg l. s. 8. Oriskany. 10 a. Marcellus. 11 b. Chemung, gap. 12. Catskill. 13 a. Pocono tunnel. 13 b. Mauch Ck. r. s. 14 a. Pott.con. on top.	0 Philadelphia.	1. Azolic.
18 Three Springs.		2 Gray's Ferry. ¹⁷⁸	"
		13 Chester. ¹⁷⁹	"
		14 Lamokin.	"
		16 Thurlow.	"
		18 Linwood.	"
		20 Claymont.	"
		22 Holly Oak.	"
		23 Belleview.	"
20 Saltillo.		26 Edge Moor.	"
		28 Wilmington.	"

(Continued in Maryland.)

173. "Round Top," "Cemetery Hill," "Macfarlane's Hill" and "Culp's Hill," forming the ridge on which the Union Army fought the great battle of Gettysburg, July 3d and 5d, 1863, are all trap dikes. This is a good place to study these curious formations. The scenery is beautiful and full of historical interest. (See the description of the 16. Triassic formation.)

174. By Charles A. Ashburner, assistant on the second geological survey of Pennsylvania.

175. Jack's Mountain on the west, 5 a. Medina, with 5 b. Clinton fossil ore on its flanks. Blue Ridge, 5 a. Medina, in the distance on the east. End of Chestnut Ridge, southeast from station, composed of Lewistown on 9 Upper Helderberg limestone and 8 Oriskany sandstone.

176. On the east Blacklog Mountain, 5 a. Medina. Shade Mountain also Medina. Blacklog Valley. Between them is anticlinal 3 c. Chazy and 4 a. Trenton limestone.

177. Coal openings on both sides of the railroad. The two upper seams worked, the lower seam not worked.

178. The Huronian (?) is here decomposed into Kaolin.

179. The road runs on the edge of the Azolic, masked by drift all the way to Wilmington.

ELEVATIONS.—The elevation above tide water of every railway station in Pennsylvania can be found in Report N. of the Second Geological Survey of this State, by Charles Allen, Assistant Geologist, 1877.

Ohio.*

GEOLOGICAL FORMATIONS FOUND IN OHIO.

	GROUPS.	OHIO SUB-DIVISIONS.	EQUIVALENTS IN OTHER STATES.
Quat'y.	20. QUATERNARY.	{ 20 d. Alluvium, Peat. 20 c. Lacustrine Deposits. 20 b. Forest Bed. 20 a. Erie Clay.	Alluvium, Peat, General Loess, Missouri, Illinois, etc. [ada, etc. Erie Clay, Boulder Clay, Can-
	14. COAL MEASURES.	{ 14 c. Upper Barren Measures. 14 c. Upper Coal Group. 14 b. Lower Barren Measures. 14 b. Lower Coal Group.	Upper Barren Measures, Pa. Upper Coal Group, Pa. Lower Barren Measures, Pa. Lower Coal Group, Pa.
Carboniferous.	CONGLOMERATE.	14 a. Conglomerate.	Seral Conglomerate, Pa.
	CARBONIFEROUS LIMESTONE.	14 a. Maxville Limestone.	Chester Limestone, Illinois.
	18. WAYERLY.	{ 13 d. Cuyahoga Shale. 13 c. Berea Grit. 13 b. Bedford Shale. 13 a. Cleveland Shale.	{ Vespertine, Pennsylvania. Kinderhook Group, Ill. Marshall Group, Michigan. Knobstones, Kentucky.
	11. ERIE.	11. Erie Shale.	{ 11 b. Chemung, New York. 11 a. Upper Portage, N. Y.
Devonian.	10. HURON.	{ 10 c. Huron Shale.	{ 10 c. Gardeau and Genesee Shales, New York. 10 c. U. Cadent Blk. Shale VIII. of Pa. & Va. [etc. 10 c. Bk. Sh. Ky., Tenn., Ia.,
	10. HAMILTON.	10. Hamilton Limestone.	10. Hamilton Group, N. Y.
	9. CORNIFEROUS.	{ 9 b. Sandusky Limestone. 9 a. Columbus Limestone.	{ 9. Corniferous and Onondaga Limestone, N. Y.
	8. ORISKANY.	8. Oriskany Sandstone ?	8. Oriskany Sandstone, N. Y.
Upper Silurian.	7. HELDERBERG.	7. Waterlime.	7. Waterlime, New York.
	6. SALINA.	6. Salina Shales and Gypsum.	6. Salina Group, New York.
	5. NIAGARA.	{ 5 h. Hillsboro Sandstone. 5 g. Cedarville Limestone. 5 f. Springfield Limestone. 5 e. West Union Limestone. 5 d. Niagara Shale. 5 c. Dayton Stone. 5 b. Clinton Limestone. 5 a. Medina Shale.	5. Niagara Group, New York, etc. 5 b. Clinton Group, N. Y. 5 a. Medina Group, N. Y.
	4. CINCINNATI.	{ Lebanon Beds. Cincinnati Beds. Point Pleasant Beds.	4 a. Hudson and 4 c. Trenton Groups, New York.
L. Silurian.	2 & 3. PRIMORDIAL. [In borings.]	{ 3 a. Yellow Magnesian l. s. 3 a. Yellow Massive s. s.	3 a. Calci's sandrock? N. Y. 2 b. Pot'm sandstone? N. Y.

*Prepared by Prof. J. S. Newberry, Chief Geologist of Ohio.

Ohio.

Ashtabula, Youngstown and Pittsburg Railroad.		Atlantic & Great Western R. R.—Continued.	
Ms.		Ms.	Mahoning Division.
0 L.S. & M.S.R.R.		0 Sharon.	
1 Ashtabula.	11. Erie Shale.	7 Hubbard.	14 b. Coal Measures.
8 Austinburg.	"	15 Youngstown.	13. Wav'y & 14 a. Cong.
12 Eagleville.	"	23 Niles.	"
16 Rock Creek.	"	31 Leavittsburg.	"
24 Orwell.	" & 13. Waverly.	40 Mahoning.	14 b. Cl. Mres. "
29 Bloomfield.	13. Waverly.	51 Mantua.	"
34 Bristolville.	"	57 Aurora.	14 a. Conglomerate.
40 Champion.	"	65 Solon.	"
45 Warren.	"	75 Newburg.	13. Waverly.
50 Niles.	"	80 Cleveland.	11. Erie Shale.
55 Girard.	{ 13. Waverly, 14 a.	Niles and New Lisbon Branch.	
60 Youngstown.	{ Cong., 14 b. Cl. Mres.	0 Niles.	13. Wav'y & 14 a. Cong.
65 Struther's.	14 b. Coal Measures.	6 Austintown.	14 b. Coal Measures.
68 Lowell.	"	12 Canfield.	"
Atlantic and Great Western Railroad.		18 Green.	"
0 Cincinnati.		23 Leetonia.	"
59 Dayton.	4. Cincinnati Group.	25 Franklin.	"
70 Osborne.	"	33 New Lisbon.	"
76 Enon.	"	Liberty and Vienna Branch.	
80 Springfield.	5. Niagara.	0 Vienna.	14 b. Coal Measures.
89 Bowlingville.	"	8 Vienna Junction.	"
95 Urbana.	5. Niag. & 7. Helderbg.	Baltimore, Pittsburg & Chicago, (B. & O. R. R.)	
105 Mingo.	7. Helderberg.	0 Chicago Junc'n.	
114 Pottersburg.	"	8 Attica.	9. Corni's & 10. Huron.
121 Broadway.	"	16 Republic.	9. Corniferous.
129 Richwood.	"	24 Tiffin.	5. Niag. & 7. Held'berg.
138 Green Camp.	"	30 Bascom.	5. Niagara.
144 Marion.	9. Corniferous.	37 Fostoria.	"
153 Caledonia.	"	44 Bloombdale.	5. Niag. & 7. Held'berg.
164 Galion.	13. Waverly.	50 New Baltimore.	
172 Ontario.	"	62 Deshler.	7. Helderberg.
179 Mansfield.	"	74 Holgate.	
187 Windsor.	"	88 Defiance.	10 c. Huron Shale.
196 Ashland.	"	94 Delaware.	"
207 Polk.	"	Central Ohio Railroad.—(B. & O. R. R.)	
213 West Salem.	"	0 Baltimore, Md.	
216 Burbank.	"	376 Bellaire.	14 b. Coal Measures.
221 Pike.	"	385 Glencoe.	"
225 Russel.	"	395 Belmont.	"
232 Wadsworth.	14 b. Coal Measures.	403 Barnesville.	"
240 New Portage.	14 a. Conglomerate.	413 Salesville.	"
246 Akron.	"	428 Cambridge.	"
250 Tallmadge.	14 b. Coal Measures.	437 Concord.	"
256 Kent.	14 a. Conglomerate.	447 Sonora.	"
263 Ravenna.	14 b. Coal Measures.	454 Zanesville.	"
269 Freedom.	"	468 Pleasant Valley.	"
279 Braceville.	13. Waverly.	470 Black Hand.	13. Waverly.
283 Leavittsburg.	"	480 Newark.	"
286 Warren.	"	486 Union.	"
294 Cortland.	"	495 Pataskala.	"
307 Orangeville.	14 b. Coal Measures.	504 Taylor's.	10. Huron & 13. Wav'y.
		513 Columbus.	9 Cor., 10 Ham. & 19 W.

*The railroads of this State are arranged in alphabetical order.

Cincinnati, Hamilton and Dayton R. R.

0 Cincinnati.	4. Cincinnati Group.
5 Cummins ville.	"
15 Glendale.	"
19 Jones.	"
25 Hamilton.	"
37 Middletown.	"
49 Miamisburg.	"
60 Dayton.	"

Cincinnati, Hamilton & Indianapolis R. R.

0 Cincinnati.	4. Cincinnati Group.
25 Hamilton.	"
32 McGonigle.	"
39 Oxford.	"
44 College Corners.	"

Cincinnati & Muskingum Valley Railroad.

0 Cincinnati.	4. Cincinnati Group.
36 Morrow.	"
46 Clarksville.	"
56 Wilmington.	4 Cin., 5 a Clin. & 5 a Ni.
66 Sabina.	5. Niagara.
77 Washington.	7. Helderberg.
87 New Holland.	10 c. Huron Shale.
95 Williamsport.	"
104 Circleville.	"
116 Amanda.	13. Waverly.
125 Lancaster.	"
130 Bremen.	"
134 New Lexington.	14 b. Coal Measures.
152 Roseville.	"
157 Zanesville.	"
168 Ellis.	"
176 Dresden Junct.	"

Cincinnati, Richmond & Chicago Railroad.

0 Cincinnati.	4. Cincinnati Group.
25 Hamilton.	"
36 Collinsville.	"
44 Camden.	"
53 Eaton.	5 a. Clinton & 5 c. Niag.
60 Florence.	"
70 Richmond, Ind.	See Indiana.

Cleveland, Columbus, Cincinnati and Indianapolis Railroad.

0 Cleveland.	11. Erie Shale.
13 Berea.	13. Waverly.
25 Grafton.	"
36 Wellington.	"
47 New London.	"
55 Greenwich.	"
67 Shelby.	"
70 Vernon.	"
76 Crestline.	"
80 Gallion.	"
93 Gilead.	10. Huron & 13. Wav.
97 Cardington.	10 c. Huron Shale.
104 Ashley.	"
114 Delaware.	9 Cor., 10 Ham. & 10 Hu
122 Lewis Center.	10. Huron.
129 Worthington.	"
138 Columbus.	9 Cor., 10 Ham & 10 Hu

Cleveland, Columbus, Cincinnati and Indianapolis Railroad—Continued.

Indianapolis Division.	
Ms.	
80 Gallion.	13. Waverly.
92 Caledonia.	9. Corniferous.
101 Marion.	"
111 N. Bloomington.	7. Helderberg.
122 Mt. Victory.	"
132 Rushsylvania.	"
141 Bellefontaine.	7 Hel., 9 Cor. & 10 c Hu.
150 De Graff.	5. Niagara.
157 Pemberton.	"
164 Sidney.	"
182 Versailles.	"
190 Ansonia.	"
197 Union.	"

Cincinnati Division.

0 Delaware.	9 Cor., 10 Ham. & 10 c Hu
9 Ostrander.	9. Corniferous.
17 Marysville.	7. Helderberg.
22 Milford.	"
32 Mechanicsburg.	5. Niag. & 7. Heldberg.
43 Moorfield.	5. Niagara.
50 Springfield.	"
63 Osborn.	4. Cincinnati Group.
74 Dayton.	"
81 Carrollton.	"
90 Franklin.	"
99 Henderson.	"
108 Maud's.	"
120 Carthage.	"
130 Cincinnati.	"

Cleveland, Mt. Vernon & Columbus R.R.

0 Hudson.	13 a. Conglomerate.
7 Cuyahoga Falls.	"
14 Akron.	"
27 Clinton.	14 b. Coal Measures.
38 Orrville.	13. Waverly.
52 Fredericksburg.	13 Wa., 14 a Con. Cl. M.
61 Millersburg.	"
81 Gann.	"
90 Howard.	13. Waverly.
100 Mt. Vernon.	"
109 Mt. Liberty.	"
124 Sunbury.	13. Wav. & 10. Huron.
133 Westerville.	10. Huron.
145 Columbus.	9 Cor., 10 Ham. & 10 Hu

Cleveland and Pittsburg Railroad.

0 Cleveland.	11. Erie Shale.
8 Newburg.	13. Waverly.
14 Bedford.	"
26 Hudson.	14 a. Conglomerate.
38 Ravenna.	14 b. Coal Measures.
52 Limaville.	"
57 Alliance.	"
63 Homeworth.	"
69 Bayard.	"
81 Millport.	"
87 Salineville.	"
94 Irondale.	"
102 Wellsville.	"

Cleveland & Pittsburg Railroad—Continued.		Ms.	Columbus and Xenia Railroad.	
River Division.				
0 Bellaire.	14 b. Coal Measures.		0 Columbus.	9 Cor., 10 Ham. & 10 Hu
6 Martin's Ferry.	"		9 Alton.	9. Corniferous.
13 Portland.	"		25 London.	"
20 La Grange.	"		41 Selma.	5. Niagara.
26 Steubenville.	"		55 Xenia.	4 Cin., 5 a Clin. & 5 Nia.
35 Sloan's.	"		Dayton and Michigan Railroad.	
46 Wellsville.	"		0 Cincinnati.	
Tuscarawas Branch.			60 Dayton.	4. Cincinnati Group.
0 Bayard.	14 b. Coal Measures.		74 Tippecanoe.	"
8 Malvern.	"		87 Troy.	"
12 Waynesburg.	"		88 Piqua.	4 Cin., 5 a Clin. & 5 Niag
28 Zoar.	"		100 Sidney.	5. Niagara.
32 New Philadel'a.	"		119 Wapakoneta.	7. Helderberg.
Cleveland, Tuscarawas Valley & Wheeling Railroad.			131 Lima.	"
0 Uhrichsville.	14 b. Coal Measures.		144 Columbus Grove.	"
12 Dover.	"		151 Ottawa.	"
23 Barr's Mills.	"		165 Deshler.	"
35 Massillon.	"		176 Weston.	8. Oriskany & 9. Corn.
48 Warwick.	"		182 Tontogany.	7. Helderberg.
59 Russel.	13. Waverly.		193 Perrysburg.	"
72 Medina.	"		202 Toledo.	"
85 Grafton.	"		Dayton and Union Railroad.	
16 Black River.	10. Huron.		0 Dayton.	4. Cincinnati Group.
Columbus, Chicago & Indiana Central R. R.			12 Brookville.	4 Cin., 5 a Clin. & 5 Niag
0 Columbus.	9 Cor., 10 Ham. & 10 Hu		21 Baltimore.	5. Niagara.
18 Pleasant Valley.	7. Helderberg.		28 Arcanum.	"
28 Milford Center.	"		35 Greenville.	"
38 Cable.	"		47 Union.	"
47 Urbana.	7. Helderb. & 5. Niaga.		Lake Erie and Louisville Railroad.	
58 St. Paris.	5. Niagara.		0 Fremont.	7. Helderberg.
73 Piqua.	4 Cin., 5 a Clin. & 5 c Nia		10 Burgoon.	5. Niagara.
83 Bradford Junct.	5. Niagara.		21 Fostoria.	"
95 Greenville.	"		27 Arcadia.	"
108 New Madison.	"		37 Findlay.	" & 7. Helderberg.
114 New Paris.	"		45 Rawson.	7. Helderberg.
0 Bradford Junct.	"		52 Bluffton.	"
10 Pikeville.	"		58 Beaver Dam.	"
21 Union.	"		68 Lima.	"
Continued in Indiana.			Lake Shore & Michigan Southern Railroad.	
Columbus and Hocking Valley Railroad.			Main Line.	
0 Columbus.	9 Cor., 10 Ham. & 10 Hu		0 Buffalo, N. Y.	See N. Y.
12 Groveport.	10. Huron.		116 Conneaut.	11. Erie Shale.
23 Carroll.	13. Waverly.		129 Ashtabula.	"
32 Lancaster.	"		138 Geneva.	"
42 Millville.	"		144 Madison.	"
50 Logan.	"		155 Painesville.	"
60 Lick Run.	13. Wav. & 14 b. Cl. Ms.		174 Nottingham.	"
62 Nelsonville.	"		183 Cleveland.	"
70 Salina.	14 b. Coal Measures.		196 Berea.	13. Waverly.
76 Athens.	"		209 Elyria.	"
Columbus, Springfield & Cincinnati R. R.			217 Oberlin.	"
0 Springfield.	5. Niagara.		227 Wakeman.	"
11 Plattsburg.	" & 7. Helderberg.		239 Norwalk.	"
20 London.	7. Helderberg.		243 Monroeville.	10. Huron.
32 Georgesville.	9. Corniferous.		251 Bellevue.	" & 9. Corniferous.
45 Columbus.	9 Cor., 10 Ham. & 10 Hu		258 Clyde.	7. Helderberg.
			267 Fremont.	"
			279 Elmore.	5. Niagara.
			296 Toledo.	7. Helderberg.

Lake Shore & Michigan Southern Railroad.**Ms. | Main Line—Continued.**

338 Wauseon.	10. Huron.
353 Stryker.	"
360 Bryan.	"
370 Edgerton.	"
0 Elyria.	13. Waverly.
10 Brownhelm.	"
14 Vermillion.	10 c. Huron.
21 Ceylon.	"
34 Sandusky.	9. Corniferous.
46 Port Clinton.	7. Helderberg.
58 Oak Harbor.	5. Niagara.
65 Graytown.	7. Helderberg.

Franklin Division.

0 Ashtabula.	11. Erie Shale.
11 Jefferson.	"
24 Andover.	13. Waverly.
30 Simon.	"
36 Jamestown.	See Pa.

Little Miami Railroad.

0 Cincinnati.	4. Cincinnati Group.
9 Plainville.	"
17 Miamiville.	"
23 Loveland.	"
36 Morrow.	"
45 Freeport.	"
56 Claysville.	"
65 Xenia.	4 Cinn., 5 Clin. & 5 Niag.

Mansfield, Coldwater & Lake Michigan R.R.

0 Toledo.	7. Helderberg.
6 Walbridge.	"
18 Woodville.	5. Niagara.
26 Helena.	"
31 Burgoon.	"
42 Tiffin.	" & 7. Helderberg.
52 Bloomville.	9. Corniferous.
62 New Washing'n	10 c. Huron & 10. Haml.
75 Vernon.	13. Waverly.
86 Mansfield.	"

Marietta and Cincinnati Railroad.

0 Cincinnati.	4. Cincinnati Group.
5 Cummins ville.	"
20 Remington.	"
31 Cozaddale.	"
41 Blanchester.	"
50 Martinsville.	5. Niagara.
62 Lexington.	"
74 Greenfield.	7. Helderberg.
85 Frankfort.	10. Huron.
98 Chillicothe.	" and 13. Waverly.
105 Schooley's.	13. Waverly.
117 Raysville.	14 a Cong. & 14 b Cl. Ms.
127 Hamden.	14 b. Coal Measures.
139 Zaleski.	"
152 Marshfield.	"
159 Athens.	"

Ms. | Marietta & Cincinnati R. R.—Cont.

169 New England.	14 b. Coal Measures.
178 Cutler.	"
195 Moore's Junct.	"
199 Marietta.	"
41 Blanchester.	4. Cincinnati Group.
52 Lynchburg.	"
62 Hillsboro.	5. Niagara.
127 Hamden.	14 b. Coal Measures.
139 Jackson.	14 a Con. & 14 b Cl. Ms.
146 Vaughn's.	14 b. Coal Measures.
155 Washington.	"
165 Webster.	"
177 Scioto ville.	13. Waverly.
183 Portsmouth.	" and 10. Huron.
159 Athens.	14 b. Coal Measures.
170 Guysville.	"
182 Coolville.	"
187 Little Hocking.	"

Marietta, Pittsburg & Cleveland Railroad.

0 Marietta.	14 b. Coal Measures.
7 Caywood.	"
18 Warner.	"
27 Dexter.	"
36 Caldwell.	"
45 Glenwood.	"
59 Cambridge.	"
70 Kimbolton.	"
80 New Comerst'n.	"
90 Phillipsburg.	"
100 Dover.	"

Ohio and Mississippi Railroad.

0 Cincinnati.	1. Cincinnati Group.
9 Delhi.	"
13 North Bend.	"

Painesville and Youngstown Railroad.

0 Youngstown.	13. Wav. & 14 b. Cl. Ms.
9 Niles.	13. Wav. & 14 a. Congl.
15 Warren.	13. Waverly.
25 Southington.	"
31 Bundysburg.	14 a. Conglomerate.
38 Burton.	"
48 Chardon.	"
59 Painesville.	11. Erie Shale.

Pittsburg, Cincinnati & St. Louis Railroad.

0 Columbus.	9 Cor., 10 Ham. & 10 c Hu
10 Black Lick.	13. Waverly.
17 Pataskala.	"
33 Newark.	"
41 Hanover.	14 b. Coal Measures.
49 Frazeyburg.	"
55 Dresden Junct.	"
62 Conesville.	"
69 Coshocton.	"
75 West Lafayette.	"
83 N. Comerstown.	"
89 Port Washing'n	"

Pittsburg, Cincinnati and St. Louis Railroad—Continued.

0 Pittsburg.	See Pa.
97 Trenton.	14 b. Coal Measures.
100 Uhrichsville.	"
110 Bowerstown.	"
121 Fairview.	"
130 Unionport.	"
138 Smithfield.	"
150 Steubenville.	"

Pittsburg, Fort Wayne & Chicago Railroad.

0 Chicago.	See Indiana.
168 Dixon.	7. Helderberg.
173 Convo.	"
181 Van Wert.	"
193 Delphos.	"
201 Elida.	"
208 Lima.	"
216 Lafayette.	"
222 Ada.	"
232 Dunkirk.	"
239 Forest.	5. Niagara.
251 Upper Sandusky.	7. Helderberg.
259 Nevada.	9. Corniferous.
267 Bucyrus.	9 Cor., 10 Ha. & 10 c Hu
280 Crestline.	13. Waverly.
293 Mansfield.	"
307 Perrysville.	" [Cl. Ms.
318 Lakeville.	13 Wa., 14 c Con. & 14 b
333 Wooster.	13. Waverly. [Cl. Ms.
344 Orrville.	13 Wa., 14 c Con. & 14 b
359 Massillon.	14 b. Coal Measures.
367 Canton.	"
379 Strasburg.	"
385 Alliance.	"
392 Damascus.	"
405 Leetonia.	"
414 Nor. Waterford.	Cont'd in Pa.

Sandusky, Mansfield and Newark Railroad—(B. & O. R. R.)

0 Sandusky.	9. Corniferous.
8 Prout's.	10. Hamilton.
15 Monroeville.	10 c. Huron.
23 Havana.	13. Waverly.
28 Chicago Junct.	"
35 Plymouth.	"
42 Shelby Junct'n.	"
49 Spring Mill.	"
54 Mansfield.	"
63 Lexington.	"
74 Independence.	"
84 Frederick.	"
91 Mt. Vernon.	"
103 Utica.	13. Wav. & 14 b. Cl. Ms.
116 Newark.	13. Waverly.

Straitsville, Somerset and Newark Railroad

0 Newark.	13. Waverly.
9 Avondale.	14 b. Coal Measures.
17 Glenford.	"
27 Wellans.	"
38 Bristol.	"
43 Shawnee.	"

Wabash, (Late Toledo, Wabash & Western.)

0 Toledo.	7. Helderberg.
9 South Toledo.	"
17 White House.	9. Corniferous.
29 Liberty.	10 c. Huron.
35 Napoleon.	10. Hamil. & 10 c. Hu.
52 Defiance.	"
61 Emerald.	10. Hamilton.
71 Antwerp.	9. Corniferous.
94 Ft. Wayne.	See Indiana.

Michigan.¹

LIST OF THE GEOLOGICAL FORMATIONS OF MICHIGAN.

PROBABLE EQUIVALENTS OF DANA.		LOCAL DESIGNATIONS.	
20. Quaternary. ²		20. Quaternary, Lacustrine Drift. ²	
14 c. Upper Coal Measures.		14 c. Coal Measures.	
14 a. Millstone Grit.		14 a. Parma Sandstone.	
13 b. Upper Sub-Carboniferous.		13 b. Carboniferous Limestone.	
"		13 b. Michigan Salt Group.	
13 a. Lower Sub-Carboniferous.		13 a. Marshall Group.	
11 b. Chemung.		11. Huron Group, Chemung Shale.	
11 a. Portage.		11. Huron Group, Portage Shale.	
10 c. Genesee.		11. Huron Group, Black Shale.	
10 b. Hamilton.		10 b. Little Traverse Group.	
9 c. Corniferous and 9 b. Schoharie.		9. Corniferous Group.	
7. Lower Helderberg.		7. Lower Helderberg.	
6. Salina.		6. Salina Group.	
5 c. Niagara.		5. Niagara Group,	
5 b. Clinton.		"	
4 c. Cincinnati.		4 c. Cincinnati.	
4 a. Trenton.		4 a. Trenton Group.	
3. Canadian.		3 c. and 3 a. Chazy and Calciferous.	
2 b. Potsdam.		2 b. Lake Superior Sandstone.	
(Products of Eruption.)		2-4. Lower Siluro-Conglomerate.	
1 b. Huronian.		1 b. Huronian.	
1 a. Laurentian.		1 a. Laurentian.	

Ms. Michigan Central Railroad.		Michigan Central Railroad.	
		Air Line Division—Continued.	
0 Detroit.	10 b. Little Traverse, beneath Lacustrine.	124 Sherwood.	11. Hur. Kid'y Iron Ore.
3 Gd. Trunk Jun.	11. Huron, ben. Lacust.	129 Colon.	"
10 Dearborn.	"	136 Wasepi.	"
17 Wayne.	"	140 Centreville.	"
30 Ypsilanti.	13 a. Marshall? L. Ridge	145 Three Rivers.	"
38 Ann Arbor.	" Deep Drift.	152 Corey's.	"
43 Delhi.	13 b. Mich. Salt, "	160 Vandalia.	10 b. L. Traverse? } Deep Drift.
47 Dexter.	"	165 Cassopolis.	"
55 Chelsea.	13 b. Carb. Limestone?	170 Dailey.	9. Corniferous.
62 Francisco.	"	174 Barron Lake.	"
66 Grass Lake.	"	179 Niles.	"
69 Leoni.	"	Kalamazoo Division.	
76 Jackson.	14 c. Coal Meas. Mines.	76 Jackson.	
Air Line Division.		81 Trumbull's.	14 c. Coal Measures.
76 Jackson.	14 c. Coal Meas. Mines.	87 Parma.	14 a. Parma s.s. outcrop
83 Snyder's.	13 b. Carb. Limestone.	92 Bath's Mills.	13 b. Carb. Limestone.
90 Concord.	"	96 Albion.	"
99 Homer.	13 a. Marshall.	101 Marengo.	13 a. Marshall.
103 Clarendon.	"	108 Marshall.	" Outcrops.
109 Tekonsha.	"	113 Ceresco.	"
117 Union City.	11. Hur. Kid'y Iron Ore.	115 White's.	"

1. This chapter was prepared for this work by Prof. Alexander Winchell, L.L.D., of the Syracuse University, former Director of the Geological Survey of Michigan.

2. The rocky formations of the Lower Peninsula are deeply and generally covered by drift. In all the western half of the State, south of Little Traverse Bay, no good characteristic exposures exist, save in Kent county and near Holland in Ottawa county. Hence in most cases our knowledge of the underlying rocks is only a matter of inference.

Michigan Central Railroad.			Michigan Central Railroad—Continued.		
Ms.	Kalamazoo Division—Continued.		Ms.	Saginaw Division.	
121	Battle Creek.	13 a. Marshall, outcrops.	0	Jackson.	14 c. Coal Mrs. Mines.
126	Bedford.	"	11	Rives Junction.	"
130	Augusta.	"	15	Leslie.	"
135	Galesburg.	" ?	25	Mason.	"
140	Comstock.	11. Huron.	37	Lansing.	"
144	Kalamazoo.	"	53	Laingsburg.	"
149	Ostemo.	"	65	Owosso.	"
156	Mattawan.	"	87	St. Charles.	" Lacustrine.
160	Lawton.	"	101	Saginaw City.	" "
162	White Oaks.	"	103	East Saginaw.	" "
168	Decatur.	"	105	Carrollton.	" "
172	Glenwood.	10 b. L. Traverse ?	116	Wenona.	" "
179	Dowagiac.	9. Corniferous ?	121	Bay City. ³	" "
185	Pokagon.	"	Mackinaw Division.		
191	Niles.	"	0	Bay City. ⁴	14 c. Coal Mrs., Lacus.
197	Buchanan.	"	6	Kawkawlin.	"
202	Dayton.	"	29	Standish.	"
205	Galien.	"	41	Wells.	"
209	Avery's.	"	54	West Branch.	13 b. Michigan Salt.
211	Three Oaks.	"	67	St. Helenas.	" ?
218	New Buffalo.	" Sand Dunes.	78	Roscommon.	" ?
(Continued in Indiana.)			93	Grayling.	13 b. Carb. Limestone.
Grand Rapids Division.			102	Forrest.	13 a. Marshall.
0	Jackson.	14 c. Coal Measures.	113	Otsego Lake.	" ?
10	Rives Junction.	"	121	Gaylord.	" ?
17	Onondaga.	"	Bay City Division.		
24	Eaton Rapids.	"	0	Detroit.	10 b. L. Traverse.
35	Charlotte.	"	10	Norris.	11. Huron, Lacust.
40	Chester.	"	14	Warren.	"
46	Vermontville.	"	17	Oakwood.	"
50	Nashville.	14 a. Parma Sandstone ?	24	Utica.	"
55	Sheridan.	13 b. Carb. Limestone.	29	Yates.	"
62	Hastings.	"	31	Rochester.	13 a. Marshall.
73	Middleville.	"	35	Goodison's.	"
79	Caledonia.	"	41	Orion.	"
85	Hammond.	"	44	Oxford.	13 b. Mich. Salt.
94	Grand Rapids.	" Extensive exposures.	52	Metamora.	"
South Haven Division.			60	Lapeer.	"
0	Kalamazoo.	11. Huron.	61	Junction.	"
8	Alamo.	"	64	Millville.	13 b. Carb. Limestone.
14	Kendell's.	"	65	Carpenter's.	"
17	Pine Grove.	"	70	Columbiaville.	"
18	Gables.	"	74	Otter Lake.	13 b. Michigan Salt.
22	Bloomington.	"	80	Millington.	14 a. Parma Sandstone.
24	Bear Lake.	"	87	Vassar.	14 c. Coal Measures.
27	Columbia.	"	95	Reese.	"
29	Grand Junction.	"	110	Bay City. ⁴	"
31	Geneva.	"	Lake Shore & Michigan Southern R. R.		
39	South Haven.	"	Michigan Division.		
South Bend Division.			0	Cleveland.	
0	Niles.	9. Corniferous.	113	Toledo.	9. Corniferous.
5	Bertrand.	"	123	Sylvania.	"
9	Notre Dame.	"	130	Ottawa Lake.	"
11	South Bend.	"	133	Riga.	"
			135	Blissfield.	10 b. Little Traverse.

3. Lacustrine deposits of Saginaw Valley 100 feet deep.

4. The shallow salt wells here are supplied from the base of the Coal Measures.

Lake Shore & Michigan Southern R. R.			Lake Shore & Mich. Southern R. R.—Con.		
Ms.	Michigan Division—Continued.		Ms.	Kalamazoo Division.	
139	Palmyra.	11. Huron.	0	White Pigeon.	11. Huron.
141	Lenawee Junct.	"	4	Constantine.	"
145	Adrian.	"	12	Three Rivers.	"
155	Clayton.	"	17	Moore Park.	"
162	Hudson.	13 a. Marshall.	20	Flowerfield.	"
168	Pittsford.	"	24	Schoolcraft.	"
172	Osseo.	"	30	Portage.	"
178	Hillsdale.	" Ext. Quarries.	37	Kalamazoo.	"
182	Jonesville.	" "	43	Cooper.	13 a. Marshall.
187	Allen's.	" "	46	Argenta.	"
194	Quincy.	11. Huron.	49	Plainwell.	"
200	Coldwater.	" worked for Brick.	52	Otsego.	"
215	Bronson.	"	62	Allegan.	"
218	Burr Oak.	"	70	Hopkins.	"
224	Sturgis.	"	73	Hilliards.	"
229	Douglas.	"	77	Dorr.	13 b. Michigan Salt?
236	White Pigeon.	"	83	Byron Center.	"
			89	Grandville.	"
			93	Eagle Mills.	13 b. Carb. Limestone.
			95	Grand Rapids.	" Exposures.
Detroit Division.			Lansing Division.		
0	Toledo.	9. Corniferous.	0	Jonesville.	13 a. Marshall, exposu.
7	West Toledo.	"	7	Litchfield.	"
10	Alexia.	"	14	Homer.	"
15	Vienna.	"	22	Albion.	13 b. Carb. Limestone.
20	La Salle.	"	29	Devereux.	14 a. Parma Sandstone.
25	Monroe Junct'n	" & L. Helder'g.	33	Springport.	"
25	Monroe Junct.	9. Corniferous.	38	Charlesworth.	14 c. Coal Measures.
32	Newport.	"	42	Eaton Rapids.	"
38	Rockwood.	"	52	Diamondale.	"
44	Trenton.	" exposu.	59	South Lansing.	"
48	Wyandotte.	10 b. L. Traver.	60	Lansing.	"
51	Ecorces.	"			
57	Gd. Trunk Jun.	11. Huron.			
62	Det. & Mil. Jun	"			
65	Detroit.	10 b. L. Traver.			
0	Monroe Junct'n	9. Corniferous.			
10	Ida.	6. Salina, exposures.			
17	Petersburg.	9. Corniferous.			
20	Deerfield.	"			
26	Wellsville.	10 b. Little Traverse.			
29	Lenawee Junct.	11. Huron.			
33	Adrian.	"			
Jackson Division.			Grand Rapids and Indiana Railroad.		
0	Adrian.	11. Huron.	0	Cincinnati, O.	(See Indiana.)
4	Lenawee Junct.	"	143	Lima.	11. Huron.
8	Chase's.	"	147	Sturgis.	"
13	Tecumseh.	"	157	Nottawa.	"
18	Clinton.	13 a. Marshall.	159	Wasepi.	"
25	Manchester.	"	163	Mendon.	"
32	Norvell.	"	168	Portage Lake.	"
36	Napoleon.	" Exposures ex-	173	Vicksburg.	"
40	Eldred.	tensively quarried.	178	Austin.	"
46	Jackson.	13 b. Carb. Limestone?	185	Kalamazoo.	"
		14 c. Coal Measures.	194	Travis.	13 a. Marshall.
			197	Plainwell.	"
			202	Monteith.	"
			203	Martin.	"
			207	Shelby.	"
			210	Bradley.	" ?
			213	Wayland.	13 b. Michigan Salt.
			221	Ross.	"
			227	Fisher.	13 b. Carb. Limestone.
			234	Grand Rapids.	"
			237	D. & M. Cross'g	"
			244	Belmont.	"

Generally conceal-
ed by drift.Generally beneath
limestone deposits.

5. Extensive quarries, exposing in places the waterlime of Lower Helderberg.

Ms. | Flint & Marquette R. R.—Continued.

209 Chippewa.	14 c. Coal Mres.	No rock exposures. Drift 200 to 300 feet.
213 Sears.	"	
217 Ewart.	"	
226 Hersey.	"	
230 Reed City.	?	
237 Chase.	?	
239 Summitville.	?	
241 Nirvana.	?	
248 Baldwin.	13 b. Carb. l. s.	
264 Weldon Creek.	"	
272 Amber.	"	
278 Ludington.	"	

Flint River Division.

0 Flint.	14 c. Coal Measures.
4 Junction.	"
8 Genesee.	"
14 Otisville.	14 a. Parma Sandstone.
19 Otter Lake.	13 b. Michigan Salt.
142 East Saginaw.	14 c. Coal Measures.
153 Portsmouth.	"
155 Bay City.	"

Detroit, Lansing & Lake Michigan R. R.

0 Detroit.	10 b. Little Traverse.
3 Gd. Trunk Jun.	11. Huron.
13 Redford.	"
15 Fisher's.	"
16 Elmwood.	"
19 Livonia.	13 a. Marshall.
23 Plymouth.	"
29 Salem.	"
34 South Lyon.	13 b. Carb. Limestone.
43 Brighton.	14 a. Parma Sandstone.
46 Genoa.	14 c. Coal Measures.
52 Howell.	"
57 Fleming.	"
60 Fowlerville.	"
65 Le Roy.	"
71 Williamston.	" Outcrops.
76 Meridan.	"
79 Okemos.	"
85 Lansing.	"
86 North Lansing.	"
92 Delta.	"
94 Ingersoll's.	"
97 Grand Ledge.	" Outcrops.
102 Eagle.	"
106 Danby.	"
109 Portland.	"
114 Collins.	"
118 Lyons.	"
122 Ionia.	" Quarries in upper sandstone.
0 Ionia.	14 c. Coal Measures.
5 Stanton Junc'n.	"
9 Wood's Corners	"
14 Fenwick.	"
19 Sheridan.	"
24 Stanton.	"

Conc'd

Ms. | Detroit, Lansing and Lake Michigan Railroad—Continued.

122 Ionia.	14 c. Coal Mres.	Beneath drift, from 100 to 200 feet deep.
130 Palmer's.	"	
133 Chadwick.	"	
135 Kiddville.	"	
141 Greenville.	"	
146 Gowen.	"	
151 Trufant's.	"	
153 Maple Valley.	"	
156 Coral.	"	
160 Howard.	"	

Chicago and Michigan Lake Shore R. R.

Chicago.	
0 New Buffalo.	9. Cornif., Sand Dunes.
7 Chickaming.	"
10 Troy.	"
15 Bridgeman.	"
16 Morris.	"
20 Stevensville.	"
28 St. Joseph.	"
30 Benton Harbor.	"
39 Coloma.	" ?
42 Watervliet.	10 b. Little Traverse ?
47 Hartford.	11. Huron.
54 Bangor.	"
58 Breedsville.	"
62 Grand Junction.	"
75 Rennsville.	"
79 Richmond.	" [fossils.
90 Holland.	13 a. Marshall, outcrops
90 Holland.	13 a. Marshall.
95 Zeeland.	"
104 Hudsonville.	"
110 Grandville.	13 a. Michigan Salt.
115 Grand Rapids.	13 b. Carb. Limestone.
90 Holland.	13 a. Marshall.
99 Olive.	"
109 Robinson.	"
110 Nunica.	"
116 Fruitport.	"
126 Muskegon.	"
126 Muskegon.	13 a. Marshall.
130 B. R. Junction.	"
136 Twin Lake.	"
142 Holton.	"
150 Fremont Centre	"
160 Allyton.	13 b. Carb. Limestone.
161 Morgan.	"
170 Traverse Road.	"
181 Big Rapids.	14 c. Coal Measures.
126 Muskegon.	13 a. Marshall.
142 Whitehall.	"
143 Montague.	13 b. Michigan Salt.
157 Shelby.	13 b. Carbon, l. s., extensive detached tables.
163 Mears.	13 b. Carb. Limestone.
170 Pentwater.	"

Grand Rapids, Newaygo and Lake Shore Railroad.		Ms.	Grand Trunk Railroad.	
0 Grand Rapids.	13 b. Carb. Limestone.		196 Port Huron.	11. Huron.
7 Alpine.	"		207 Smith's Creek.	"
14 Sparta.	"		217 Ridgeway.	"
19 Tyrone.	"		223 New Haven.	"
21 Casinovia.	"		237 Mount Clemens.	"
25 County Line.	"		250 Milwaukee Jun.	"
27 Ashland.	"		255 Detroit Junct'n.	"
30 Grant.	"			10 b. L. Trav.
36 Newaygo.	"			Drift over 100
39 Croton.	"			feet deep.
46 Morgan.	"			
67 Big Rapids.	14 c. Coal Measures.			
Detroit, Hillsdale and S. W. Railroad.			Chicago and Lake Huron Railroad.	
0 Ypsilanti.	13 a. Marshall.		Eastern Division.	
11 Saline.	"		0 Port Huron.	11. Huron.
17 Bridgewater.	"		4 Gd. Trunk Jun.	"
28 Manchester.	"		10 Thornton.	"
36 Brooklyn.	"		19 Emmet.	"
41 Woodstock.	"		27 Capac.	13 a. Marshall.
44 Somerset.	"		34 Imlay City.	"
49 Jerome.	"		39 Attica.	"
53 North Adams.	"		46 Lapeer.	13 b. Michigan Salt.
61 Hillsdale.	" Outcrops foss.		53 Elba.	13 b. Carb. Limestone.
65 Banker's.	"		57 Davison.	14 a. Parma Sandstone.
Reading.	11. Huron.		66 Flint.	14 c. Coal Measures.
Camden.	"			
Chicago and Canada Southern Railroad.			Peninsular Division.	
0 Fayette.	11. Huron.		0 Lansing.	14 c. Coal Measures.
7 Morenci.	"		5 Millett's.	"
13 Weston.	"		10 Sevastopol.	"
17 Fairfield.	10 b. Little Traverse.		12 Pottsville.	"
20 Ogden.	"		19 Charlotte.	"
25 Blissfield.	"		27 Olivet.	14 a. Parma Sandstone.
32 Deerfield.	"		32 Bellevue.	13 b. Car. l.s., quar. fos.
36 Petersburg.	"		37 Madison.	13 b. Michigan Salt.
40 Dundee.	9. Corniferous.		45 Battle Creek.	13 a. Mar., outcro. foss.
42 Nor. Rainsville.	" ext. quarries.		55 Climax.	13 a. Marshall.
47 Maybee.	"		60 Scott's.	11. Huron.
50 Exeter.	"		64 Indian Lake.	"
55 Carlton.	"		68 Vicksburg.	"
57 Bryar Hill.	"		74 Schoolcraft.	"
61 Flat Rock.	"		85 Marcellus.	"
67 Slocum Junct'n.	"		89 Volinia.	"
			94 Jamestown.	10 b. Little Traverse.
			98 Cassopolis.	9. Corniferous.
			106 Edwardsburg.	"
				(Continued in Indiana.)
Toledo, Canada Southern and Detroit R. R.			Saginaw Valley and St. Louis Railroad.	
0 Detroit.	10 b. Little Traverse.		0 East Saginaw. ⁹	
2 M. C. Junction.	11. Huron.		2 Saginaw.	14 c. Coal Measures.
9 Ecorces.	10 b. Little Traverse.		6 Tittabawassee J	"
12 Wyandotte.	"		9 Swan Creek.	"
16 Trenton.	9. Corniferous.		11 Graham's.	"
17 Slocum Junct'n.	"		12 Sand Ridge.	"
	" & 7. L. Heldb.		16 Hemlock.	"
	ext. expos. & quarries.		16 Porter's.	"
15 Stony Creek.	9. Corn. & 7 L. Heldb.		22 West Mill.	"
20 Monroe.	9. Corniferous.		26 Wheeler's.	"
25 La Salle.	"		28 Breckenridge.	"
30 Vienna.	"		35 St. Louis.	"
34 Alexis.	"		Elm Hall.	"
40 Toledo.	"			

Deep Quaternary deposits. Many surface signs of Petroleum.

Deep l.a. deposits.

Chicago & North-Western Railroad.			Chicago & North-Western Railroad.		
Ms. Green Bay and Lake Superior Line.			Ms. Green Bay and Lake Superior Line—Con.		
0	Chicago, Ill.	(See Wisconsin.)	389	Negaunee.	1 b. Hur'n, Iron Mines.
264	Menomonee.	4 a. Trenton.	393	Ishpeming.	" "
273	Little River.	"	401	Marquette.	"
279	Wallace.	"	441	L'Anse.	2 b. Lake Superior s. s.
285	Stephenson.	"	Marquette, Houghton & Ontonagon R.R.		
291	Gravel Pit.	"	0	Marquette.	1 b. Huronian.
295	Bagley.	"	3	Bancroft.	"
302	Kloman.	"	7	Morgan.	"
305	Spaulding.	"	8	Eagle Mills.	"
316	Bark River.	"	12	Negaunee.	" Iron Mines.
321	Ford River.	"	15	Ishpeming.	" Exten. Mines.
323	Escanaba.	"	21	Greenwood.	"
331	Flat Rock.	"	25	Clarksburg.	"
333	Bay Siding.	"	26	Humboldt.	"
337	Mason.	"	35	Republic.	"
340	Day's River.	"	31	Champion.	" Iron Mines.
345	Beaver.	"	38	Michigamme.	" "
352	Maple Ridge.	"	47	Sturgeon.	1 a. Laurentian.
357	Centreville.	"	56	Palmer.	1 b. Huronian.
362	Helena.	3 a. Calc. & 3 c. Chazy.	63	L'Anse.	2 b. Lake Superior s. s.
369	Little Lake.	2 b. Lake Superior s. s.	93	Houghton.	} 2-4. Eruptive rocks, with Native Copper Mines.
370	Smith Mine Jun	1 a. Laurentian.	93	Hancock.	
382	Cascade Junc'n.	1 b. Huronian.			
384	Goose Lake.	"			

Indiana.

LIST OF THE GEOLOGICAL FORMATIONS FOUND IN INDIANA.

20. Quaternary.*	13 b. Upper Sub-Carbonifer's.	9 c. Corniferous.
15. Permian ?	13 a. Lower Sub-Carbonifer's.	8. Oriskany.
14 c. Upper Coal Measures.	10 c. Genesee.	5 c. Niagara.
14 b. Lower Coal Measures.	10 b. Hamilton.	5 b. Clinton.
14 a. Millstone Grit.		4 c. Cincinnati.

Michigan Central Railroad.		Lake Shore and Michigan Southern R.R.	
Ms.		Ms.	Air Line Division—Continued.
0 Chicago.	(See Illinois.)	47 Corunna.	5 c. Niagara.
23 Gibson's.	5 c. Niagara.	50 Sedan.	"
29 Tolleston.	"	54 Waterloo.	"
35 Lake.	"	62 Butler.	"
44 Porter.	"	69 Edgerton.	"
50 Furnessville.	"	(Continued in Ohio.)	
56 New Buffalo.	"		
(Continued in Michigan.)			
Joliet Division.		Baltimore and Ohio Railroad.	
0 Lake.	5 c. Niagara.	Chicago Division.	
7 Ross.	"	0 Chicago.	(See Illinois.)
14 Dyer.	"	34 Mich. Cen. Jun.	5 c. Niagara.
45 Joliet, Ill.	(See Illinois.)	50 L. N. A. & C. Jun.	"
Lake Shore and Michigan Southern R.R.		58 Wellsboro.	"
Western Division.		72 Walkerton Jun.	"
0 Chicago.		89 Bremen.	"
14 Colehour.	5 c. Niagara.	106 Milford Junc'n.	"
30 Miller's.	"	110 Syracuse.	"
41 Chesterton.	"	118 Cromwell.	"
45 Burdick.	"	128 Albion.	"
49 Otis.	"	138 Avilla.	"
51 Holmesville.	"	143 Garrett.	"
59 Laporte.	"	146 Auburn Junc'n.	"
66 Rolling Prairie.	"	147 Auburn.	"
73 New Carlisle.	"	163 Hicksville.	"
75 Terre Coupee.	"	Pittsburg, Fort Wayne and Chicago R.R.	
80 Warren.	"	0 Chicago.	(See Illinois.)
86 South Bend.	"	16 Sheffield.	5 c. Niagara.
90 Mishawaka.	"	20 Cassello.	"
96 Osceola.	"	24 Clarke.	"
101 Elkhart.	"	31 Liverpool.	"
Air Line Division.		37 Wheeler.	"
0 Elkhart.	5 c. Niagara.	44 Valparaiso.	"
10 Goshen.	"	53 Wanatah.	"
18 Millersburg.	"	59 Hanna.	"
25 Ligonier.	"	78 Donelson.	"
30 Wawaka.	"	84 Plymouth.	"
34 Brimfield.	"	95 Bourbon.	"
41 Kendallville.	"	99 Etna Green.	"
		104 Selby.	"
		109 Warsaw.	"

* Four-fifths of the State of Indiana is covered with drift. It is 90 feet to the rock in Indianapolis. At some points north of Wabash River the drift has been bored into 200 feet. It thins out as you go toward Ohio River, does not reach it at some points, and is sparingly found south of that stream.

Pittsburg, Fort Wayne and Chicago Railroad—Continued.		Pittsburg, Cincinnati and St. Louis R. R. Second Division—Continued.	
115 Kosciusko.	5 c. Niagara.	193 Power's.	5 c. Niagara.
117 Pierceton.	"	197 Ridgeville.	"
122 Larwill.	"	200 Deerfield.	"
129 Columbia.	"	203 Warren.	"
140 Arcola.	"	210 Union.	"
148 Fort Wayne.	75-2-75 "	(Continued in Ohio.)	
158 Maples.	"	Columbus, Chicago & Indiana Central Division.	
(Continued in Ohio.)		0 Chicago.	
Pittsburg, Cincinnati and St. Louis R. R. First Division.		117 Logansport.	8. Orisk. & 10 b. Ham
0 Indianapolis.	10 c. Genesee.	122 Anoka.	10 b. Hamilton.
11 Cumberland.	"	127 Walton.	"
17 Philadelphia.	"	130 Lincoln.	"
21 Greenfield.	10. Hamilton.	133 Galveston.	"
28 Cleveland.	"	139 Kokomo.	"
30 Charlottesville.	"	145 Tampico.	"
34 Knightstown.	"	149 Nevada.	"
35 Raysville.	"	152 Windfall.	"
38 Ogden's.	5 c. Niagara.	157 Curtisville.	"
39 Dunreith.	"	161 Elwood.	"
44 Lewisville.	"	166 Frankton.	"
51 Dublin.	"	171 Florida.	"
53 Cambridge City.	"	175 Anderson.	9 c. Cornif. & 8. Orisk.
58 Germantown.	"	Bellefontaine Crossing.	"
63 Centerville.	4 c. Cincinnati.	184 Middletown.	5 c. Niagara.
68 Richmond.	"	187 Honey Creek.	"
74 New Paris.	"	190 Sulphur Springs.	"
79 Wiley's.	"	195 Junction.	"
(Continued in Ohio.)		197 New Castle.	"
Second Division.		201 Ashland.	"
0 Chicago.	5 c. Niagara.	204 Millville.	"
20 Dalton.	"	208 Hagerstown.	"
27 Lansing.	"	215 Washington.	"
34 Sherville.	"	Centreville Pike	"
41 Crown Point.	"	224 Richmond.	4 c. Cincinnati.
47 Cassville.	"	Indianapolis and Vincennes Division.	
51 Hebron.	"	0 Indianapolis.	10 c. Genesee.
61 Koutt's.	"	4 Maywood.	"
67 La Crosse.	"	8 Valley Mill.	"
77 North Judson.	"	11 West Newton.	"
91 Winimac.	"	12 Friendswood.	"
97 Star City.	"	16 Mooresville.	"
101 Rosedale.	"	18 Mathews'.	"
105 Royal Centre.	"	20 Brooklyn.	"
111 Gebhardt.	"	23 Centerton.	"
117 Logansport.	8. Oriskany & 10 b. Ham	26 Hastings.	"
121 Anoka.	10 b. Hamilton.	30 Martinsville.	"
127 Onward.	"	33 Hynds.	"
132 Bunker Hill.	"	37 Paragon.	"
140 North Grove.	"	44 Gosport.	13 b. Upper Sub-Carb.
142 Amboy.	"	53 Spencer.	"
145 Converse.	"	62 Freedom.	"
148 Mier.	"	65 Farmer's.	14 a. Millstone Grit.
157 Marion.	5 c. Niagara.	71 Worthington.	14 a. Mills. Gr. & 14 b. L.
162 Jonesboro.	"	78 Switz City.	" Cl. Mrs.
169 Upland.	"	82 Lyons.	"
175 Hartford.	"	87 Marco.	"
183 Dunkirk.	"	97 Edwardsport.	14 c. Upper Coal Mrs.
189 Red Key.	"	108 Bruceville.	"
		117 Vincennes.	"

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Detroit and Eel River Railroad.		Cincinnati, Lafayette and Chicago Railroad—Continued.	
Ms.		Ms.	
0 Logansport.	8. Orisk. & 10 b. Ham.	35 Earl Park	13 b. Upper Sub-Carb.
18 Denver.	5 c. Niagara.	41 Raub.	"
21 Chili.	"	46 Sheldon.	"
27 Roann.	"	Indianapolis, Bloomington & Western R. R.	
33 Laketon.	"	0 Indianapolis.	10 c. Genesee.
37 N. Manchester.	"	14 Brownsburg.	"
45 Collamer.	"	18 Pittsboro.	13 a. Lower Sub-Carb.
47 South Whitley.	"	22 Lizton.	"
51 Taylor's.	"	27 Jamestown.	"
56 Columbia City.	"	33 New Ross.	13 b. Upper Sub-Carb.
62 Collin's.	"	44 Crawfordsville.	"
66 Cherubusco.	"	54 Waynetown.	14 a. Millstone Grit.
70 Potter's.	"	65 Veedersburg.	14 a. Mill. Gt. & 14 b. L.
74 C. R. Crossing.	"	72 Covington.	14 c. " Coal Mrs.
76 Cedar Creek.	"	85 Danville, Ill.	14 c. "
81 Auburn Junc'n.	"	(Continued in Illinois.)	
82 Auburn.	"	Cleveland, Columbus, Cincinnati and Indianapolis Railroad.	
88 Mooresville.	"	Indianapolis Division.	
93 Butler.	"	0 Indianapolis.	10 c. Genesee.
Wabash Railroad.		9 Lawrence.	"
(Late Toledo, Wabash and Western Railroad.)		14 Oakland.	"
0 Toledo.	(See Ohio.)	16 McCord's.	"
88 New Haven.	5 c. Niagara	21 Fortville.	"
94 Fort Wayne.	"	28 Pendleton.	8. Orisk. & 9 c. Cornif.
109 Roanoke.	"	35 Anderson.	9 c. Cornif. & 8. Orisk.
118 Huntington.	5 c. Niag. & 10 b. Ham.	41 Chesterfield.	"
131 Lagro.	"	43 Daleville.	5 c. Niagara.
136 Wabash.	"	48 Yorktown.	"
150 Peru.	"	54 Muncie.	"
157 Waverly.	"	60 Selma.	"
166 Logansport.	8. Orisk. & 10 b. Ham.	67 Farmland.	"
180 Rockfield.	10. b. Hamilton.	75 Winchester.	"
186 Delphi.	10 c. Genesee.	84 Union.	"
195 Buck Creek.	"	(Continued in Ohio.)	
203 Lafayette.	13 a. Lower Sub-Carb.	Indianapolis and St. Louis Railroad.	
213 West Point.	"	0 Indianapolis.	10 c. Genesee.
225 Attica.	14 a. Millstone Grit.	2 Asylum.	"
233 West Lebanon.	"	6 Sunnysid	"
242 State Line.	14 c. Upper Coal Mrs.	8 Spray.	"
(Continued in Illinois.)		12 Avon.	"
L. M. & B. Division.		16 Easton.	"
0 Lafayette June.	13 a. Lower Sub-Carb.	19 Danville.	13 a. Lower Sub-Carb.
8 Porter's.	"	23 Hadley.	"
10 Montmorency.	"	27 Reno.	"
21 Templeton.	13 b. Upper Sub-Carb.	31 Malta.	13 b. Upper Sub-Carb.
23 Oxford.	"	32 Darwin.	"
29 Boswell.	"	38 Greencastle.	13 b. U. Sub-Car. & 14 a
37 Ambia.	"	44 Fern.	" Mills. Grit.
Cincinnati, Lafayette & Chicago Railroad.		48 Lena.	14 a. Millstone Grit.
Cincinnati.	10 c. Genesee.	53 Carbon.	14 b. Lower Coal Mrs.
Indianapolis.	13 a. Lower Sub-Carb.	56 Perth.	"
0 Lafayette.	"	61 Fountain.	"
7 Porter's.	"	64 Grant.	14 c. Upper Coal Mrs.
9 Montmorency.	"	67 Markle.	"
13 Otterbien.	"	69 Gravel Pit.	"
18 Templeton.	13 b. Upper Sub-Carb.	72 Terre Haute.	"
23 Atkinson.	"		
28 Fowler.	"		

Union Depot
St. Louis, Vandalia, Terre Haute and Indianapolis Railroad.

0 Indianapolis. 700	10 c. Genesee.
4 Fairview.	"
9 Bridgeport.	13 a. Lower Sub-Carb.
14 Plainfield.	"
17 Cartersburg.	"
19 Belleville.	"
20 Clayton.	"
25 Amo.	"
28 Coatsville.	"
33 Fillmore.	13 b. Upper Sub-Carb.
39 Greencastle.	13 b. & 14 a. Mills. Gt.
43 Hamrick's.	14 a. Millstone Grit.
47 Reelsville.	"
50 Eagle's.	"
53 Harmony.	14 b. Lower Coal Mrs.
54 Knightsville.	"
57 Brazil.	"
60 Williams.	14 c. Upper Coal Mrs.
62 Staunton.	"
65 Seeleyville.	"
73 Terre Haute. 442	"

Cincinnati, Hamilton and Indianapolis R. R.

0 Cincinnati. 500	(See Ohio.)
25 Hamilton.	4 c. Cincinnati.
32 McGonigle's.	"
39 Oxford.	"
44 College Corner.	4 c. Cincinnati.
52 Liberty.	"
58 Brownsville.	"
66 Connersville.	5 c. Niagara.
76 Glenwood.	"
84 Rushville.	"
91 Arlington.	"
98 Morristown.	5 c. Niag. & 9 c. Cornif.
103 Fountaintown.	"
123 Indianapolis. 700	10 c. Genesee.

Indianapolis, Cincinnati and Lafayette R. R.

0 Cincinnati.	(See Ohio.)
18 Valley Junction	"
20 Elizabethtown.	"
25 Lawrenceburg.	4 c. Cincinnati.
26 Newton.	"
33 Guilford.	"
34 Hansell's.	"
40 Harman's.	"
42 Weisburg.	"
46 Sunman's.	"
48 Spades.	"
51 Morris.	5 c. Niagara.
54 Batesville.	"
60 New Point.	"
62 Smith's Cross'g.	"
65 McCoy's.	"
68 Greensburg.	"
74 Adams.	"
78 St. Paul.	"
81 Waldron.	"
84 Prescott.	"

Indianapolis, Cincinnati and Lafayette Railroad—Continued.

88 Shelbyville.	10. Hamilton.
95 Fairland.	"
99 London.	"
100 Brookfield.	"
102 Acton.	"
106 Gallaudet.	10 c. Genesee.
115 Indianapolis.	"
125 Augusta.	"
130 Zionsville.	"
135 Whitestown.	"
138 Holmes.	"
143 Lebanon.	13 a. Upper Sub-Carb.
148 Hazelrigg.	"
152 Thornstown.	"
157 Colfax.	"
163 Clark's Hill.	"
166 Stockwell.	"
171 Culver's.	"
179 Lafayette.	"

Jefferson, Madison and Indianapolis R. R.

0 Indianapolis.	10 c. Genesee.
7 Southport.	"
11 Greenwood.	13 a. Lower Sub-Carb.
13 Worthsville.	"
15 Whiteland.	"
20 Franklin.	"
25 Amity.	13 a. & 10 c. Genesee.
31 Edinburg.	"
35 Taylorsville.	"
38 Lowell.	"
41 Columbus.	"
46 Walesboro.	"
48 Waynesville.	"
52 Jonesville.	"
57 Rockford.	"
59 Seymour.	"
64 Chestnut Ridge.	"
66 Langdon's.	13 a. Lower Sub-Carb.
69 Retreat.	"
71 Crothersville.	"
75 Austin.	10 b. Hamilton.
77 Marshfield.	"
82 Vienna.	"
89 Henryville.	"
93 Memphis.	"
100 Sellersburg.	"
108 Jeffersonville.	"

Ohio and Mississippi Railroad.

0 Cincinnati.	(See Ohio.)
26 Lawrenceburg.	4 c. Cincinnati.
24 Aurora.	"
26 Cochran.	"
33 Dillsboro.	"
37 Cold Springs.	"
40 Moore's Hill.	"
42 Milan.	"
45 Pierceville.	"
47 Delaware.	"

Ms. | Ohio & Mississippi Railroad—Continued.

52 Osgood.	5 c. Niagara.
56 Poston.	"
58 Holton.	"
62 Nebraska.	"
66 Butlerville.	"
73 North Vernon.	5 c., 9, 10 c., 10 b.
79 Hardenburgh.	10. Hamilton.
83 Fleming's.	"
87 Seymour.	"
92 Shields' Mill.	13 a. Lower Sub-Carb.
98 Brownstown.	"
101 Velonia.	"
106 Medora.	"
111 Sparksville.	"
114 Fort Ritner.	"
117 Tunnelton.	13 a. and 13 b.
121 Scotville.	13 b. Upper Sub-Carb.
127 Mitchell.	"
133 Georgia.	"
139 Huron.	13 b. & 14 a. Mills. Gt.
150 Shoals.	14 a. & 14 b. L. Cl. Mrs.
158 Loogootee.	14 b. Lower Coal Mrs.
162 Clark's.	"
165 Montgomery's.	"
MS 173 Washington.	14 c. Upper Coal Mrs.
180 Wheatland.	"
185 Richland.	"
AS 191 Vincennes.	"
(Continued in Illinois.)	

Fort Wayne and Jackson Railroad.

0 Fort Wayne.	5 c. Niagara.
16 New Era.	"
23 Auburn.	"
28 Waterloo.	"
33 Summit.	"
37 Pleasant Lake.	"
42 Angola.	"
US 50 Fremont.	"
54 State Line.	"
(Continued in Michigan.)	

Grand Rapids and Indiana Railroad.

275 Sturgis.	(See Michigan.)
286 La Grange.	5 c. Niagara.
290 Valentine.	"
295 Wolcottville.	"
297 Rome City.	"
304 Kendallville.	"
310 Avilla.	"
314 La Otto.	"
320 Hometown.	"
333 Fort Wayne.	"

Cincinnati, Richmond and Fort Wayne R.R.

333 Fort Wayne.	5 c. Niagara.
338 Adams.	"
354 Decatur.	"
360 Monroe.	"
366 Berne.	"
370 Geneva.	"

Cincinnati, Richmond and Fort Wayne Railroad—Continued.

374 Briant.	5 c. Niagara.
381 Portland.	"
392 Ridgeville.	"
400 Winchester.	"
406 Snow Hill.	"
409 Lynn.	"
416 Newport.	"
418 Haley.	"
422 Parry.	"
424 Richmond.	4 c. Cincinnati.
(Continued in Ohio, Cinn. Rich. & Ch. R.R.)	

Fort Wayne, Muncie and Cincinnati R. R.

0 Fort Wayne.	5 c. Niagara.
3 Wabash June'n.	"
7 Ferguson's.	"
11 Sheldon.	"
14 Ossian.	"
19 Eagleville.	"
24 Bluffton.	"
35 Keystone.	"
38 Montpelier.	"
47 Hartford.	"
54 Eaton.	"
65 Muncie.	"
71 McGowan's.	"
75 Springport.	"
78 Summit.	"
80 N. C. Junction.	"
83 New Castle.	"
90 New Lisbon.	"
96 Cambridge City.	"
98 Milton.	"
103 Beeson's.	"
108 Connersville.	"

Cincinnati, Wabash and Michigan Railroad.

0 Anderson June.	8, Orisk. & 9 c. Cornif.
13 Alexandria.	5 c. Niagara.
34 Marion.	"
54 Wabash.	"
69 N. Manchester.	"
90 Warren.	"
103 Milford.	"
115 Goshen.	"
125 Elkhart.	"

Indianapolis, Peru and Chicago Railroad.

0 Indianapolis.	10 c. Genesee.
6 Malott Park.	"
11 Castleton.	"
15 Fisher's.	"
17 Britton's.	"
22 Noblesville.	"
28 Cicero.	"
31 Arcadia.	"
34 Buena Vista.	"
40 Tipton.	10 b. Hamilton.
42 Jackson's.	"
46 Sharpsville.	"

**Indianapolis, Peru and Chicago Railroad—
Ms. Continued.**

49	Fairfield.	19 b. Hamilton.
54	Kokomo.	"
59	Cassville.	"
61	Bennett's.	"
63	Miami.	"
67	Bunker Hill Crg	5 c. Niagara.
75	Peru.	"
81	Courter.	"
83	Denver.	"
85	Deed's.	"
88	Birmingham.	"
90	Lincoln.	"
93	Wagner's.	"
98	Rochester.	"
102	Sturgeon.	"
103	Tiosa.	"
105	Walnut.	"
108	Railsback's.	"
110	Argos.	"
118	Plymouth.	"
125	Tyner.	"
128	Knott's.	"
132	Walkerton.	"
136	Kankakee.	"
141	Stillwell.	"
148	La Porte.	"
155	Webbers.	"
161	Michigan City.	"

Louisville, New Albany and St. Louis R.R.

0	Princeton.	14 c. Upper Coal Mres.
5	Lyle's.	"
10	Mount Carmel.	(See Illinois.)
11	C. & V. Junc'n.	"
15	Brown's.	"
19	Bellmont.	"
27	Crackle's.	"
29	Albion, Ill.	"

Louisville, New Albany and Chicago R. R.

0	New Albany.	10 c. Gen. & 13 a. L. Sub-
6	Smith's Mills.	Carb.
12	Wilson's.	"
18	Providence.	13 a. Lower Sub-Carb.
23	Pekin.	"
27	Farabee's.	"
30	Harristown.	13 b. Upper Sub-Carb.
35	Salem.	"
40	Hitchcock's.	"
45	Campbellsburg.	"
47	Saltillo.	"
52	Lancaster.	"
56	Orleans.	"
61	Mitchell.	"
65	Juliet.	"
71	Bedford.	"
78	Salt Creek.	"
82	Guthrie.	"
85	Harrodsburg.	"
89	Smithville.	"
92	Clear Creek.	"
97	Bloomington.	"

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**Louisville, New Albany and Chicago Rail-
road—Continued.**

101	Wood Yard.	13 b. Upper Sub-Carb.
104	Ellettsville.	"
109	Stinesville.	"
113	Gosport.	"
117	Spring Cave.	"
122	Quincy.	"
125	Oakland.	"
128	Cloverdale.	"
134	Putnamville.	"
139	Greencastle.	13 b. & 14 a. U. Cl. Mrs.
143	Maple Grove.	13 b. Upper Sub-Carb.
148	Bainbridge.	"
152	Carpentersville.	"
156	Ashby's.	"
159	Ladoga.	"
163	Whitesville.	"
170	Crawfordsville.	"
175	Cherry Grove.	"
180	Linden.	"
184	Corwin.	"
187	Raub's.	"
190	Taylor's.	"
198	Lafayette.	13 a. Lower Sub-Carb.
204	Battle Ground.	"
211	Brookston.	"
215	Chalmers.	"
221	Reynolds.	13 a. U. Sub-C. & 10 c. G.
229	Bradford.	10 b. Genes. & 5 c. Niag.
237	Francesville.	5 c. Niagara.
244	Medarysville.	"
252	San Pierre.	"
260	La Crosse.	"
267	Wanatah.	"
271	Haskell's.	"
273	Lake Huron Crossing.	"
276	Westville.	"
279	Otis.	"
281	Beatty's.	"
288	Michigan City.	"

Indiana North and South Railroad.

0	Attica.	14 a. Millstone Grit.
4	Rob Roy.	"
7	Strader's.	"
10	Stone Bluff.	"
11	Kirkland's.	"
12	Ludlows.	"
15	Veedersburg.	14 a. & 14 b. L. Cl. Mrs.

Evansville, Terre Haute and Chicago R.R.

0	Terre Haute.	14 c. Upper Coal Mres.
5	Ellsworth.	"
11	Atherton.	"
15	Clinton.	"
20	Summit Grove.	"
23	Hillsdale.	"
25	Highland.	"
28	Opedee.	"
31	Newport.	"
37	Eugene.	"
55	Danville, Ill.	(See Illinois.)

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Ms. Evansville and Crawfordsville R. R.			Ms. St. Louis and South-Eastern Railroad.		
0	Evansville.	14 c. Upper Coal Mres.		St. Louis.	(See Illinois.)
3	Fair Ground.	"	136	Upton.	14 c. Upper Coal Mres.
5	Erskine.	"	142	Mount Vernon.	"
10	Ingle's.	"	154	Belknap.	"
13	Stacer's.	"	161	Evansville.	"
15	St. James. }	"	(Continued in Kentucky.)		
17	Haubstadt.	"			
20	Fort Branch.	"	Cincinnati, Rockport and South-Western Railroad.		
24	King's.	"			
27	Princeton.	"			
31	Patoka.	"	0	Rockport.	{ 14 a. to 14 c. Upper & Lower Coal Mres.
38	Hazelton.	"	11	Wright's.	
40	Decker's.	"	17	Lincoln.	"
45	Purcell's.	"	20	Dale.	"
51	Vincennes.	"	24	Ferdinand.	{ 14 a. Mills. Grit & 14 b. Lower Coal Mres.
57	John Smith's.	"			
62	Emison's.	"	Lake Erie, Evansville and South-Western Railroad.		
34	Busseron.	"			
66	Oak Town.	"			
68	Griswold.	"			
70	Ehrman.	"			
73	Carlisle.	"			
77	Paxton's.	"			
83	Sullivan.	"			
88	Shelburn.	"			
93	Farmersburg.	"			
97	Hartford.	"			
101	Young's.	"			
109	Terre Haute.	"			

Illinois.¹

List of the Geological Formations on the Illinois Railroads.

18 and 19. Cretaceous or Tertiary.		5 c. Niagara Group.	
14 c. Upper Coal Measures.		4 c. Cincinnati Group.	
14 b. { Lower Coal Measures and Con-		4 a. Trenton and Galena Limestone.	
14 a. } glomerate.		3 c. St. Peter's Sandstone.	
13 a. Low. Carboniferous Limestone.*		3 a. Calciferous and Lower Magnesian Limestone.	
9-12. Devonian.			
Baltimore, Pittsburg and Chicago Railroad.		Ms. Illinois Central Railroad—Continued.	
Ms.	(B. & O.)		
0 Chicago.	5 c. Niagara.	215 Edgewood.	14 c. Upper Coal Mrs.
12 Kingston.	"	230 Kimmunity.	"
14 South Chicago.	"	244 Odin.	"
21 Edgemoor.	"	252 Central City. ⁸	"
30 Miller's.	"	253 Centralia.	"
34 Mich. Cent. Jun.	"	263 Richview.	"
		267 Ashley.	"
		274 Dubois.	"
		280 Tamaroa.	"
Illinois Central Railroad.		289 Du Quoin. ⁴	{ 14 a. & b. L. Cl. Mrs.
0 Chicago.	5 c. Niagara, 88 miles.	302 De Soto.	& Conglom., 43 ms.
14 Kensington.	"	308 Carbondale.	"
24 Homewood.	"	316 Makanda.	"
27 Matteson.	"	328 Cobden. ⁵	"
34 Monee.	"	328 Anna. ⁶	4 a. Trenton, 20 miles.
40 Peotone.	"	339 Dongola.	"
47 Manteno.	"	344 Ullin.	{ 18. & 19. Cretaceous
56 Kankakee. ²	"	365 Cairo.	{ or Tertiary, 21 miles.
65 Chebanse.	"		"
69 Clifton.	"	Dubuque to Cairo.	
81 Gilman.	"	0 Dubuque.	4 a. Trenton, 71 miles.
85 Onarga.	"	2 Dunleith. ⁷	"
93 Bulkley.	4 c. Cincinnati, 16 ms.	19 Galena. ⁷	"
99 Loda.	"	26 Council Hill. ⁷	"
103 Paxton.	"	31 Scales Mound. ⁸	"
105 Ludlow.	{ 14 a. & b. L. Cl. Mrs.	40 Apple River.	"
114 Rantoul.	& Conglom., 21 ms.	46 Warren.	"
119 Thomasboro.	"	49 Nora.	"
128 Champaign.	14 c. U. Cl. Mrs. 155 ms	57 Lena.	"
137 Tolono.	"	70 Freeport.	"
143 Pesotum.	"	74 Baileysville.	5 c. Niagara, 3 miles.
150 Tuscola.	"	82 Forreston.	4 a. Trenton, 42 miles.
158 Arcola.	"	87 Haldane.	"
173 Mattoon.	"	92 Polo.	"
185 Neoga.	"	105 Dixon. ⁹	"
199 Effingham.	"		

* Consisting of the 1. Kinderhook limestone and sandstone, 2. Burlington limestone, 3. Keokuk limestone, 4. St. Louis limestone and 5. Chester limestone and sandstone.

1. The notes are by Prof. A. H. Worthen, State Geologist of Illinois.

2. Rich in Niagara corals.

3. Shelly limestone of Upper Coal Measures filled with fossil shells, bryozoa, &c.

4. Roof shales of coal rich in fossil plants.

5. Upper Chester shales beneath conglomerate with a few fossil shells, corals, &c.

6. Quarries of St. Louis limestone with some small shells, corals, &c.

7. A few fossils characteristic of the Galena limestone.

8. Rich fossiliferous band near the base of the Cincinnati group, and crystals of barite, pyrite and dolomite in pockets of the Galena limestone.

9. Lower Trenton or Blue limestone two miles northeast of Dixon full of characteristic fossils.

Illinois Central Railroad.		Chicago, Burlington and Quincy Railroad—	
Ms.	Dubuque to Cairo—Continued.	Ms.	Continued.
117	Amboy.	140	Galva.
125	Sublette.	148	Altona.
133	Mendota.	152	Oneida.
141	Dimmick.	156	Wataga.
149	La Salle. ¹⁰	164	Galesburg.
158	Tonica.	179	Monmouth. ¹⁵
169	Wenona.	186	Kirkwood.
180	Minonk.	198	Sagetown. ¹⁶
188	Panola.	207	Burlington.
191	El Paso.	164	Galesburg.
200	Hudson.	173	Abingdon.
207	Normal.	183	Avon.
209	Bloomington. ¹¹	186	Prairie City.
227	Wapella.	192	Bushnell.
231	Clinton.	203	Macomb.
240	Maroa.	210	Colchester. ¹⁷
253	Decatur.	212	Tennessee.
258	Wheatland.	223	Plymouth.
263	Macon.	227	Augusta.
269	Moawequa.	242	Camp Point.
276	Assumption.	252	Fowler.
285	Pana.	263	Quincy. ¹⁸
303	Ramsey. ¹²	Galesburg and Peoria Division.	
315	Vandalia.	164	Galesburg.
330	Patoka.	169	Knoxville.
339	Sandoval.	180	Maquon.
344	Central City.	188	Yates City.
345	Centralia.	190	Elmwood.
358	Cairo.	209	Kickapoo.
Chicago, Burlington and Quincy Railroad.		217	Peoria.
0	Chicago.	Galena Junction.	
30	Naperville.	0	Galena Junction.
38	Aurora.	5	Niagara.
43	Oswego. ¹³	6	East Batavia.
47	Bristol.	13	Aurora.
53	Plano.	Fox River Line.	
57	Sandwich.	0	Aurora.
61	Somonauk.	5	Niagara, 6 miles.
67	Leland.	6	Oswego.
74	Earl.	13	Yorkville.
84	Mendota.	23	Millington.
100	Malden.	28	Sheridan.
105	Princeton.	32	Serena.
112	Wyanet.	36	Wedron.
118	Buda.	40	Dayton.
124	Neponsett.	44	Ottawa.
132	Kewanee. ¹⁴	60	Streator.

10. Limestone of the Upper Coal Measures full of fossils.

11. Minute shells in roof of coal seam, probably No. 3.

12. Upper Coal Measure limestone with fossil shells near Ramsey.

13. Cincinnati group rich in fossils.

14. Fossils in roof shales of coal seam, probably coal No. 5 or 6.

15. Outcrop of Burlington limestone 2 miles north of Monmouth.

16. Burlington limestone rich in fossils.

17. Roof shales of coal rich in fossil plants, coal No. 2.

18. Burlington limestone rich in fossils.

19. Fossils abundant in roof shales of coal No. 5.

20. Fossils in roof shales of coals No. 2 and 3.

21. Fossils in roof shales of coal No. 5.

Chicago, Burlington & Quincy R. R.—Cont.
 Ms. | Buda and Rushville Branch.

0 Buda.	14 b. Lower Coal Mrs.
20 Wyoming.	"
38 Brimfield.	"
45 Elmwood.	"
47 Yates City.	"
53 Farmington.	"
64 Canton. ¹⁹	"
78 Lewiston. ²⁰	"
95 Vermont.	"
110 Rushville. ²¹	"

Geneva Branch.

0 Aurora.	5. Niagara.
9 Batavia.	"
13 Geneva.	"

Mendota and Clinton Branch.

0 Mendota.	4 a. Trenton.
9 La Moille.	"
19 Ohio.	"
26 Walnut.	"
32 Deer Grove.	4 c. Cincinnati.
45 Prophetstown.	5. Niagara.
62 Fulton.	4 c. Cincinnati.
66 Clinton.	"

Galva, New Boston and Keithsburg.

0 Galva.	13 a. Lower Coal Mrs.
14 Woodhull.	"
37 Aledo.	"
51 New Boston.	"
54 Keithsburg.	"

Burlington, Carthage and Quincy.

0 Burlington.	13 a. L. Carb. Limest.
10 Lomax.	"
24 Adrian.	"
32 Carthage.	"
44 West Point.	"
58 Mendon.	"
62 Ursa.	"
72 Quincy.	"

Rock River Division.

0 Shabbona.	4 c. Cincinnati, 3 miles.
8 Paw Paw.	4 a. Trenton.
16 Brooklyn.	4 c. Cincinnati, 5 miles.
26 Amboy.	4 a. Trenton.
37 Harmon.	4 c. Cincinnati.
47 Rock Falls.	"

Chicago, Rock Island and Pacific Railroad.
 Ms. |

0 Chicago.	5. Niagara, 48 miles.
16 Blue Island.	"
30 Mokena.	"
40 Joliet.	"
51 Minooka.	{ 14 a. Cong. and 14 b. L. Coal Mrs. 41 ms.
61 Morris. ²²	"
71 Seneca.	"
76 Marseilles.	"
84 Ottawa.	3 a. Calciferous, 9 ms.
94 Utica.	"
99 La Salle.	{ 14 b. Low. Coal Mrs. and Conglomerate.
100 Peru. ²³	"
114 Bureau.	"
0 Bureau.	"
13 Henry.	"
20 Sparland.	"
28 Chillicothe.	"
46 Peoria. ²⁴	"
Pekin.	"
Jacksonville.	"

114 Bureau.	14 L. Coal Mrs. & Congl.
122 Tiskilwa.	"
136 Sheffield.	"
146 Annawan.	"
152 Atkinson.	"
159 Geneseo.	"
170 Colona.	"
179 Moline. ²⁵	"
182 Rock Island. ²⁵	"

Chicago and Alton Railroad.

0 Chicago.	5. Niagara.
26 Lemont. ²⁶	"
33 Lockport. ²⁶	"
38 Joliet. ²⁶	"
53 Wilmington. ²⁷	4 c. Cincinnati.
58 Braidwood. ²⁸	{ 14 a. & 14 b. Conglo. and Lower Coal Mrs.
61 Braceville. ²⁸	"
65 Gardner.	"
74 Dwight.	"
82 Odell.	"
92 Pontiac.	"
103 Chenoa.	"
111 Lexington.	14 c. U. Cl. Mrs. 120 ms
119 Towanda.	"
124 Normal.	"
126 Bloomington.	"
146 Atlanta.	"
157 Lincoln.	"

22. Fossil plants abundant in roof shales of coal No. 2.

23. Limestone of Upper Coal Measures full of fossils.

24. Fossils in roof shales and limestone over coal No 5.

25. Fine outcrops of Devonian shale and limestone between these points full of fossils.

26. Niagara fossils occur sparingly at each of these points.

27. Fossils abundant in Cincinnati group.

28. Fossil plants in roof shales of coal No. 2.

Ms. Chicago & Alton Railroad—Continued.		Chicago, Pekin and South-Western Railroad—Continued.	
164 Broadwell.	14 c. Upper Coal Mres.	108 Minonk.	14 c. Upper Coal Mres.
185 Springfield. ²⁹	"	124 Roanoke.	"
194 Chatham.	"	126 Eureka.	"
206 Virden.	"	133 Washington.	"
210 Girard.	"	141 Morton.	"
214 Nilwood.	"	145 Groveland.	14 a. & b. L. Cl. Mres.
223 Carlinville. ³⁰	{ 14 a. & b. Low. Coal Mrs. & Congl. 22 ms.	153 Pekin.	"
238 Shipman.	"	161 Peoria.	"
245 Brighton. ³¹	"	Jacksonville Division.	
257 Alton. ³²	13 a. L. Carb. l. s. 2 ms	126 Bloomington.	14 c. Upper Coal Mres.
258 Upper Alton.	{ 14 a. & b. Low. Coal Mres. and Conglom.	149 Hopedale.	"
261 Milton.	"	157 Delavan.	14 a & 16 b. L. Cl. Mres.
269 Mitchell.	13 a. Lower Carb. l. s.	171 Mason City.	"
276 Venice.	"	187 Petersburg.	"
280 East St. Louis.	"	200 Ashland.	"
		215 Jacksonville.	"
		Roodhouse.	"
126 Bloomington.	14 c. Upper Coal Mres.	Western Division.	
149 Hopedale.	"	0 Chicago.	14 a. & b. L. Cl. Mres.
157 Delavan.	{ 14 a. & b. Lower Coal Measures and Congl.	74 Dwight.	"
171 Mason City.	"	96 Streator.	"
187 Petersburg. ³³	"	109 Wenona.	14 c. Upper Coal Mres.
215 Jacksonville.	"	118 Varna.	"
242 Drake.	13 a. Lower Carb. l. s.	128 Lacon.	14 a. & b. L. Cl. Mres.
265 Pleasant Hill.	"	118 Varna.	14 c. Upper Coal Mres.
274 Quincy Junction.	5. Niagara.	122 La Rose.	"
St. Louis, Louisiana, Quincy, Keokuk, Burlington and St. Paul Line.		128 Washburn.	"
0 East St. Louis.	13 a. Lower Carb. l. s.	133 Cazenovia.	"
3 Venice.	"	137 Metamora.	"
16 Edwardsville Jr.	14 a. and b.	144 Washington.	"
23 Alton.	13 a. Lower Carb. l. s.	Cairo and St. Louis Railroad.	
28 Godfrey.	14 a. and b.	0 East St. Louis.	13 a. Low. Carbon. l. s.
36 Delhi.	"	13 East Carondelet.	"
43 Jerseyville.	"	14 Columbia. ³⁴	"
48 Kane.	13 a. Lower Carb. l. s.	19 Attica.	"
56 Carrollton. ³⁴	"	28 Waterloo. ³⁷	"
65 Whitehall. ³⁵	"	32 Cambria.	"
69 Roodhouse.	14 a. and b.	37 Red Bud. ³⁸	"
Chicago, Pekin and South-Western R.R.		45 Baldwin.	"
0 Chicago.	5. Niagara.	54 Sparta. ³⁹	14 a. & b. L. Cl. Mres.
37 Joliet.	"	75 Ava.	"
89 Streator.	14 a. & b. L. Cl. Mres.	90 Murphysboro. ⁴⁰	14 a. Low. Carbon. l. s.
93 Reading.	"	116 Jonesboro. ⁴¹	9-12. Devonian.
98 Long Point.	"	135 Hodge's Park.	19. Tertiary.
		147 Cairo.	"

29. Fossils abundant in roof shales of coal No. 8, and also in that of No. 5, in the shafts opened in this vicinity.

30. Upper Coal Measure limestone with a few fossils.

31. Outcrop of coal No. 5. $1\frac{1}{4}$ m. west of the station with numerous fossils in the roof shales.

32. St. Louis limestone with numerous fossils.

33. Coal Measure fossils abundant in this vicinity.

34. Outcrop of Keokuk limestone with characteristic fossils 3 miles northeast of the town.

35. Keokuk limestone $1\frac{1}{4}$ miles south of town with a few characteristic fossils.

36. Outcrop of St. Louis limestone $1\frac{1}{4}$ miles east of the station with numerous fossils.

37. St. Louis limestone in heavy outcrops on Fountain creek 2 miles west of the station, and of Chester limestone $2\frac{1}{4}$ miles southwest, both formations abounding in characteristic fossils.

38. Outcrops of Chester limestone on Prairie du Long creek $2\frac{1}{4}$ miles north of the station with numerous fossils.

39. Fossils abundant in the limestone over the coal No. 6?

40. Fossil plants in roof shales and iron concretions of coal No. 2.

Ms. I Cairo and Vincennes Railroad.

0 Vincennes.	
10 St. Francisville.	14 c. Upper Coal Mrs.
25 Mount Carmel.	"
41 Grayville. ⁴²	"
56 Carmi.	"
81 Eldorado.	"
89 Harrisburg.	14 a. & b. L. Coal Mrs.
102 Stonefort.	"
126 Vienna.	13 a. Low. Carbon. 1. s.
151 Mound City.	18 & 19. Creta. & Ter'y.
157 Cairo.	"

Chicago Danville and Vincennes Railroad.

0 Chicago.	5. Niagara, 86 miles.
20 Blue Island.	"
34 Bloom.	"
38 Crete.	"
52 Grant.	"
58 Momence.	"
69 St. Anne.	"
86 Watseka.	14 a. & b. L. Coal Mrs.
108 Hoopston.	" 46 miles.
132 Danville. ⁴³	"

Chicago and North-Western Railroad.

0 Chicago.	5. Niagara.
6 Austin.	"
9 Oak Park.	"
25 Wheaton.	"
36 Geneva.	"
38 St. Charles.	"
44 Blackberry.	"
55 Cortland.	"
58 De Kalb.	"
64 Malta.	"
75 Rochelle.	4 c. Cincinnati.
84 Ashton.	"
88 Franklin.	4 a. Trenton.
98 Dixon.	"
110 Sterling.	" & 5. Niagara.
124 Morrison.	5. Niagara.
136 Fulton.	"
138 Clinton.	4 c. Cincinnati.

(Continued in Iowa.)

Green Bay and Lake Superior Line.

0 Chicago.	5. Niagara.
22 Arlington Heights.	"
26 Palatine.	"
38 Cary.	"
43 Crystal Lake.	"
51 Woodstock.	"
63 Harvard June'n	"
71 Sharon.	4 c. Cincinnati.
78 Clinton June'n.	"
91 Janesville.	"

Evansville, Terre Haute & Chicago R.R.

0 Danville.	14 c. Upper Coal Mrs.
8 Gessie.	"

**Chicago and North-Western Railroad.
Ms. | Milwaukee Division.**

0 Chicago.	5. Niagara.
12 Evanston.	"
21 Highland Park.	"
35 Waukegan.	"
45 State Line.	"

Freeport and Dubuque Line.

0 Chicago.	5. Niagara, 66 miles.
6 Austin.	"
9 Oak Park.	"
25 Wheaton.	"
30 Junction.	"
39 Clintonville.	"
42 Elgin.	"
66 Marengo.	"
78 Belvidere.	4 c. Cincinnati.
93 Rockford.	4 a. Trenton.
100 Winnebago.	"
107 Pecatonica.	"
121 Freeport.	"

Kenosha Division.

0 Rockford.	4 a. Trenton, 18 miles.
16 Poplar Grove.	"
21 Capron.	4 c. Cincinnati.
28 Harvard June'n	5. Niagara.
34 Alden.	"
45 Genoa.	"
51 Bassett's Mills.	"

Madison and St. Paul Line.

77 Caledonia June'n.	4 a. Trenton.
78 Caledonia.	"
83 Roscoe.	"
90 Beloit.	"

Chicago and Paducah Railroad.

93 Pontiac.	14 a. & b. L. Coal Mrs.
104 Fairbury.	"
126 Gibson.	"
134 Foosland.	14 c. Upper Coal Mrs.
145 Mansfield.	"
158 Monticello.	"
180 Lovington.	"
188 Sullivan.	"
200 Windsor.	"
229 Altamont.	"
99 Streator.	14 a. & b. L. Coal Mrs.
105 Newtown.	"
110 Cornell.	"
115 Rowe.	"
118 Chicago June'n.	"

Carbondale and Shawneetown Railroad.

0 Marion.	14 a. & b. L. Coal Mrs.
3 Bainbridge.	"
11 Fredonia.	"
18 Carbondale.	"

41. St. Louis limestone fossils scarce, 3 miles west of the town outcrops of Hamilton and Corniferous limestone with fossils.

42. Band of ferruginous shale abounding in Upper Coal Measure fossils.

43. Numerous fossil shells replaced with yellow pyrite occur in the roof shales of coal No. 7.

Chicago and Illinois Southern R. R.		Gilman, Clinton and Springfield Railroad.	
Ms.		Ms.	
0 Mattoon.	14 c. Upper Coal Mres.	0 Springfield.	14 c. Upper Coal Mres.
10 Nelson.	"	24 Mount Pulaski.	"
19 Hampton.	"	44 Clinton.	"
23 Bethany.	"	62 Farmer City.	
29 Dalton.	"	82 Gibson.	14 a. L. Cl. Mrs. 15 ms
33 Hervey City.	"	97 Roberts.	4 b. Cincinnati, 14 ms.
		111 Gilman.	5. Niagara, 5 miles.
Chicago and Iowa Railroad.		Wabash Railroad.	
0 Chicago.	5 c. Niagara.	Hannibal Division.	
39 Aurora.	"	0 Bluffs.	13 a. L. Sub-Carb. l. s.
57 Hinekey.	"	4 Naples.	"
64 Waterman.	"	13 Griggsville.	14 a. Lower Coal Mres.
69 Shabbona.	4 c. Cincinnati.	17 Maysville.	"
79 Steward.	"	6 Pittsfield.	"
86 Rochelle.	"	20 New Salem.	"
89 Flag Centre.	4 a. Trenton.	27 Hadley.	13 a. Low. Carbon. l. s.
94 King's.	"	37 Kinderhook, 45	"
98 Holcomb.	"	40 Hulls.	"
100 Davis Junction.	"	50 Hannibal, Mo.	"
113 Rockford.	"		
Chicago, Milwaukee and St. Paul R. R.		Illinois Midland Railroad.	
0 Chicago.	5 c. Niagara.	0 Terre Haute.	14 a. & b. L. Cl. Mrs. 27
6 Pacific Junction	"	22 Paris.	" miles.
14 Montrose.	"	27 May's.	"
24 Deerfield.	"	31 Redmon.	14 c. Upper Coal Mres.
32 Libertyville.	"	57 Arcola.	"
39 Gurnee.	"	71 Williamsburg.	"
47 Russell.	"	87 Hervey City.	"
Chicago and Pacific Railroad.		96 Decatur.	"
0 Chicago.	5. Niagara.	128 Waynesville.	"
8 Galewood.	"	142 Armington.	"
19 Salt Creek.	"	166 Morton.	"
24 Roselle.	"	166 Morton.	"
35 Elgin.	"	170 Groveland.	14 a. & b. L. Coal Mres.
50 Hampshire.	"	178 Pekin.	"
59 Genoa.	"	170 Farmdale.	"
62 Kingston.	4 c. Cincinnati.	176 Peoria.	"
74 Monroe.	4 a. Trenton.		
88 Byron.	"		
Cincinnati, Lafayette and Chicago R. R.		Indianapolis, Bloomington & Western R. R.	
0 Lafayette, Ind.	5 c. Niagara.	74 Mound City.	
46 Sheldon, Ill.		85 Danville.	14 a. & b. L. Coal Mres.
49 Iroquois.		107 St. Joseph.	"
59 St. Mary.		116 Urbana.	14 c. Upper Coal Mres.
65 St. Anne.		118 Champaign.	"
75 Kankakee.		128 Mahomet.	"
131 Chicago.		141 Farmer City.	"
Grand Tower and Carbondale Railroad.		151 Le Roy.	"
0 Grand Tower. ⁴⁴	{ 9-11. Devonian.	166 Bloomington.	"
10 Sand Ridge.	{ 13 a. L. Carbon. l. s.	177 Danver's.	"
15 Mount Pleasant.	14 a. & b. L. Coal Mres.	186 Mackinaw.	"
19 Mount Carbon.	"	193 Tremont.	
24 Carbondale.	"	202 Pekin.	14 a. & b. L. Coal Mres.
		211 Peoria.	

44. Fine outcrops of Upper Silurian and Devonian strata with characteristic fossils.

45. Fine outcrop of the Kinderhook division of the Lower Carboniferous, with characteristic fossils, and Burlington limestone capping the bluffs.

Indianapolis, Bloomington and Western Railroad—Continued.		Michigan Central Railroad—Continued.	
Ms.		Ms.	Joliet Division.
116	Urbana.	0	Lake.
118	Champaign.	5	Cincinnati.
128	Mahomet.	15	Dyer.
139	Monticello.	24	Matteson.
164	Decatur.	32	Frankfort.
		37	Spencer.
		45	Joliet.
141	Deland.		
158	Clinton.		
180	Lincoln.		
187	Burtonview.		
198	Mason City.		
219	Havana.		
Illinois and St. Louis Railroad.		Ohio and Mississippi Railroad.	
1	East St. Louis.	0	St. Louis.
5	Centreville.	2	East St. Louis.
7	Pittsburg. ⁴⁶	13	a. L. Car. 1. s. 5 ms.
11	Lenz.	10	Caseyville. ⁵⁰
15	Bellville. ⁴⁷	14	a. & b. L. Coal Mrs.
		18	O'Fallon.
		24	Lebanon.
		27	Summerfield.
		31	Trenton.
		39	Breese.
		48	Carlyle.
		61	Sandoval.
		65	Odin.
		70	Salem.
		87	Xenia.
		96	Flora.
		103	Clay City.
		118	Olney.
		130	Sumner.
		139	Lawrenceville. ⁵¹
		149	Vincennes.
Indianapolis, Decatur and Springfield R.R.		Springfield Division.	
0	Decatur.	0	Beardstown.
20	Hammond.	13	Virginia.
36	Tuscola.	29	Pleasant Plains. ⁵²
42	Camargo.	40	Bradford.
52	Newman.	44	Coal Shaft.
68	Chrisman.	45	Springfield.
76	Illiana.	53	Rochester.
		63	Edinburg.
		72	Taylorville.
		88	Pana.
		121	Altamont.
		132	Edgewood.
		146	Louis.
		153	Flora.
		174	Fairfield.
		181	Barnhill.
		194	Enfield.
		199	Sacramento.
		209	Omaha.
		216	Ridgeway.
		225	St. L. & S.E. Jn
		228	Shawneetown.
Iron Mountain, Chester and Eastern R.R.			
0	Tamaroa.	14	a. & b. L. Coal Mrs.
10	Pinckneyville. ⁴⁸		
20	Cutler.		
26	Steel's Mills.		
31	Bremen.		
41	Chester. ⁴⁹		
Jacksonville, North-Western and South-Eastern Railroad.			
0	Jacksonville.	14	a. & b. L. Coal Mrs.
12	Franklin.		
18	Waverly.		
25	Lowder.		
31	Virden.	14	c. Upper Coal Mrs.
Lake Shore and Michigan Southern R.R.			
0	Chicago.	5	c. Niagara.
7	Englewood.		
12	South Chicago.		
Michigan Central Railroad.			
0	Chicago.	5	Cincinnati.
14	Kensington.		
35	Lake.		

46. Roof shale and limestone of No. 6 coal full of fossils.

47. Another outcrop of the same.

48. Fossils in the limestone over the coal.

49. Outcrop of nearly 250 feet of Chester limestone and shale abounding in the characteristic fossils of this group.

50. Fossils in limestone and shale over coal No. 6.

51. Fossils of Upper Coal Measures abundant in shale below the mill dam and 2 miles east of town at the bridge on the wagon road.

52. Fossils in shale and limestone over coal No. 5.

Ms. Paris and Danville Railroad.		Ms. Quincy, Alton and St. Louis Railroad.	
0 Danville.	14 a. Lower Coal Mrs.	0 Quincy.	13 a. Low. Carbon. l. s.
10 Georgetown.	"	10 Fall Creek.	"
16 Ridge Farm.	"	17 Hannibal. ⁵³	"
23 Chrisman.	"	19 Hull's.	"
30 Paris.	"	36 Rockport. ⁵⁴	"
52 Marshall.	14 c. Upper Coal Mrs.	41 Pike.	5. U. Silur. Niag. group.
81 Robinson.	"	43 Louisiana. ⁵⁵	"
90 Flat Rock.	"	Springfield and North-Western Railroad.	
97 Pinkstaff.	"	0 Springfield.	14 c. Upper Coal Mrs.
102 Lawrenceville.	"	13 Athens.	14 b. Lower Coal Mrs.
103 O. & M. Junc'n	"	22 Petersburg.	"
108 Beman.	"	31 Oakford.	"
112 Vincennes.	"	47 Havana.	"
Pekin, Lincoln and Decatur Railroad.		Sycamore and Cortland Railroad.	
0 Decatur.	14 c. Upper Coal Mrs.	0 Cortland.	
9 Warrensburg.	"	5 Sycamore.	
22 Mount Pulaski.	"	St. Louis, Rock Island and Chicago Railroad.	
33 Lincoln.	"	St. Louis.	13 a. Low. Carbon. l. s.
41 Hartsburg.	"	East St. Louis.	"
51 Delavan.	14 a. & b. L. Coal Mrs.	0 Alton.	"
68 Pekin.	"	20 Upper Alton.	14 a. & b. L. Coal Mrs.
77 Peoria.	"	25 Brighton.	"
Peoria, Pekin and Jacksonville Railroad.		38 Medora.	"
0 Peoria.	14 a. & b. L. Coal Mrs.	42 Kemper.	"
10 Pekin.	"	55 Greenfield.	"
22 Manito.	"	67 Whitehall.	13 a. Low. Carbon. l. s.
27 Forest City.	"	82 Winchester. ⁵⁶	"
41 Havana.	"	87 Riggston.	14 a. & b. L. Coal Mrs.
49 Bath.	"	92 Chapin.	"
59 Chandlerville.	"	101 Arenzville.	"
68 Virginia.	"	111 Beardstown.	"
83 Jacksonville.	"	115 Frederick.	"
Peoria and Rock Island Railway.		120 Browning.	"
0 Peoria.	14 a. & b. L. Coal Mrs.	135 Vermont.	"
15 Dunlap.	"	154 Bushnell.	"
22 Princeville.	"	170 Roseville.	"
31 Wyoming.	"	182 Monmouth.	"
36 Toulon.	"	203 Rio.	"
42 Lafayette.	"	220 Orion.	"
48 Galva.	"	227 Port Byron. ⁵⁷	"
53 Bishop Hill.	"	239 Rock Island.	9-11. Devonian.
62 Cambridge.	"	242 Moline.	"
68 Osco.	"	246 Port Byron Jun.	"
80 Coal Valley.	"	255 Rock River Jun	5. Niagara.
86 Milan.	"	268 Erie.	"
91 Rock Island.	" 9-11. Dev.	278 Lyndon.	"
Pittsburg, Fort Wayne and Chicago R.R.		280 R. I. Junction.	"
0 Chicago.	5 c. Niagara.	291 Sterling.	4 a. Trenton.
13 Hobart.	"		

53. Burlington limestone and Kinderhook group.

54. Kinderhook group with a few feet of Devonian and Upper Silurian at the base of the bluff.

55. Kinderhook, Devonian and Upper Silurian, the highest bluffs capped with Burlington limestone.

56. St. Louis limestone and Lower Coal Measures with characteristic fossils.

57. Niagara limestone with numerous fossils.

Ms. St. Louis, Alton and Terre Haute R.R.		St. Louis, Vandalia and Terre Haute Railroad—Continued.	
0 East St. Louis.	13 a. Low. Carbon. l. s.	155 Dennison.	13 a. Low. Carbon. l. s.
6 Centerville.	"	158 Farrington.	"
10 Ogles.	14 a. & b. L. Coal Mrs.	166 Terre Haute.	"
13 West Bellville.	"	Toledo, Peoria and Warsaw Railroad.	
14 Bellville.	"	0 State Line.	5. Niagara.
22 Freeburg. ⁵⁸	"	2 Sheldon.	"
29 New Athens.	"	11 Watseka. ⁶²	"
47 Coulterville.	"	25 Gilman.	"
61 Pinckneyville.	"	29 La Hogue.	4 c. Cincinnati.
71 Du Quoin.	"	40 Chatsworth.	"
St. Louis and South-Eastern Railroad.		47 Forrest.	"
0 East St. Louis.	13 a. Low. Carbon. l. s.	52 Fairbury.	
14 Bellville.	14 a. & b. L. Coal Mrs.	63 Chenoa.	14 a. & b. L. Coal Mrs.
0 Bellville.	"	67 Meadows.	14 c. Upper Coal Mrs.
6 O'Fallon.	"	78 El Paso.	"
20 Reutcher's.	"	92 Eureka.	"
25 Mascoutah.	"	99 Washington.	"
32 New Memphis.	"	109 Hilton.	14 a. Lower Coal Mrs.
35 Venedy.	"	111 Peoria.	"
49 Nashville.	14 c. Upper Coal Mrs.	139 Canton.	"
60 Ashley.	"	149 Cuba.	"
69 Woodlawn.	"	171 Bushnell.	"
87 Belle River.	"	189 Blandinsville.	"
100 Shawnee Junc'n	"	195 La Harpe.	13 a. Low. Carbon. l. s.
0 Shawnee Junc'n	"	215 Burlington.	"
1 McLeansboro.	"	195 La Harpe.	"
13 Broughton.	"	200 La Crosse.	"
22 Eldorado.	"	210 Ferris.	"
30 Equality.	14 b. Lower Coal Mrs.	216 Elvaston.	"
36 Cyprese Junc'n.	"	222 Hamilton. ⁶³	"
42 Shawneetown.	"	227 Warsaw. ⁶³	"
101 McLeansboro.	14 c. Upper Coal Mrs.	Wabash Railroad.	
113 Enfield.	"	0 Toledo, (see Indiana.)	14 b. U. Cl. Mrs.
123 Carmi.	"	242 State Line.	"
131 Wabash.	"	250 Danville.	"
St. Louis, Vandalia and Terre Haute R. R.		262 Fairmount.	"
0 East St. Louis.	13 a. Low. Carbon. l. s.	269 Homer.	"
11 Collinsville.	14 a. Lower Coal Mrs.	275 Sidney.	"
19 Troy.	"	280 Philo.	14 c. Upper Coal Mrs.
30 Highland. ⁵⁹	14 b. Upper Coal Mrs.	286 Tolono.	"
40 Pocahontas.	"	303 Bement.	"
49 Greenville.	"	311 Cerro Gordo.	"
67 Vandalia.	"	323 Decatur.	"
81 St. Elmo.	"	339 Illiopolis.	"
86 Altamont.	"	348 Buffalo.	"
98 Effingham.	"	362 Springfield.	"
102 Teutopolis.	"	378 Berlin.	"
122 Greenup.	"	385 Alexander.	"
130 Casey. ⁶⁰	"	395 Jacksonville.	"
137 Martinsville.	"	413 Bluffs.	"
148 Marshall. ⁶¹	"	426 Versailles.	13 c. Low. Carbon. l. s.
151 Griffiths.	"	436 Mount Sterling.	"
		446 Clayton.	"

58. Coal shale $1\frac{1}{2}$ miles northeast of station full of fossil shells.

59. Limestone over No. 9 coal with fossils.

60. Upper Coal Measure limestone full of fossils.

61. Fossils in roof shales and limestone of coals No 5 and 6.

62. Coal Measure limestone with fossil corals and shells.

Ms. Wabash Railroad—Continued.		Ms. Western Union Railroad.	
446	Clayton.	13 c. Low. Carbon. l. s.	0 Racine. (See Wisconsin.)
453	Labuda.	"	69 Beloit. 4 a. Trenton.
462	Bowen.	"	90 Davis'. "
467	Denver.	"	103 Freeport. "
476	Carthage.	13 a. Low. Carbon. l. s.	111 Florence. 5. Niagara.
481	Elvaston.	"	117 Shannon. "
488	Hamilton.	"	124 Lanark. "
452	Camp Point.	14 b. Lower Coal Mres.	131 Mt. Carroll. ⁶³ 4 a. Trenton.
457	Coatsburg.	"	142 Savanna. ⁶⁴ 4 c. Cincinnati.
463	Fowler.	13 a. Low. Carbon. l. s.	159 Fulton. "
474	Quincy.	"	166 Albany. 14 b. Niagara.
St. Louis Division.		181 Port Byron. "	
324	Decatur.	14 c. Upper Coal Mres.	187 Hampton. 14 b. Lower Coal Mres.
331	Boody.	"	194 Moline. "
351	Taylorville.	"	197 Rock Island. Devonian.
383	Litchfield.	"	
397	Staunton.	"	
413	Edwardsville.	14 b. Lower Coal Mres.	
429	Venice.	13 a. L. Sub-Carb. l. s.	
432	East St. Louis.	"	

63. Fine outcrops of Keokuk limestone with numerous fossils, and geodes containing crystalized quartz, chalcedony, calcite, dolomite, arragonite, blende and pyrite.

64. Cincinnati group with characteristic fossils, and near Savanna the Niagara limestone caps the hills and affords silicified corals in abundance.

Wisconsin.¹

LIST OF THE GEOLOGICAL FORMATIONS IN WISCONSIN:

20. Quaternary, { Post Glacial. ² Glacial. 10. Hamilton, (Milwaukee Cement Rock.) 7. Lower Helderberg. 5 c. Niagara Limestone. ³ 5 b. Clinton. ⁴ 4 c. Cincinnati Shale. 4 b. Galena Limestone.	4 a. Trenton Limestone. ⁵ 3 c. St. Peter's Sandstone, (Chazy of New York ?) 3 a. Lower Magnesian, (Calcliferous). ⁶ 2 b. Potsdam Sandstone. ⁷ Copper bearing series. 1 b. Huronian. 1 a. Laurentian.
Chicago and North-Western Railroad. Ma. Chicago, St. Paul and Minneapolis Line.	Chicago and North-Western Railroad. Chicago, St. Paul and Minneapolis Line— <i>Con- tinued.</i>
0 Chicago. (As before.) 90 Beloit. { 4 b. Galena l. s. 4 a. Trenton l. s. 3 c. St. Peter's s. s. 98 Afton. { 4 a. Trenton l. s. 3 c. St. Peter's s. s. 104 Hanover. 4 a. Trenton limestone. 107 Footville. { 4 a. Trenton l. s. 3 c. St. Peter's s. s. 111 Magnolia. " 116 Evansville. 4 a. Trenton limestone. 122 Brooklyn. 20. Moraine Drift. 128 Oregon. { 4 a. Trenton l. s. 3 c. St. Peter's s. s. 3 c. St. Peter's s. s. 133 Syene. { 8 a. Lower Magn. l. s. 20. Quat. Mor. Drift. 3 a. Lower Magn. l. s. 138 Madison. { 2 b. Madison s. s. Mendota limestone. Potsdam sandstone. 143 Mendota. In cut, { 3 a. L. Magn. 2 b. Mad. s. s. 148 Waunakee. { 3 a. Lower Magn. l. s. on bluffs. 2 b. Potsdam s. s.	153 Dane. { 3 a. Lower Magn. l. s. (on top of high dividing ridge.) 3 a. Lower Magn. l. s. capped bluffs. 158 Lodi. { 2 b. Mad. s. s. } bluff 2 b. Mend. l. s. } sides. 2 b. Potsdam s. s. val- ley bottom. 164 Merrimac. 2 b. Potsdam sandstone. 172 Devil's Lake. { 1. Archæan Quartzite. 2 b. Potsdam sand- stone and Conglom. 175 Baraboo. { 1. Archæan Quartzite. 2 b. Potsdam s. s. 181 North Freedom. 2 b. Potsdam sandstone. 1. Archæan Quartzite. 184 Ableman's. { 2 b. Potsdam s. s. (in gorge 200 ft. deep, unconformability & exact junction.) 2 b. Potsdam sandstone. 191 Reedsburg. " 198 Lavelle. " 205 Wonowoc. " 208 Union Centre. " 212 Elroy. "

1. Prepared by Professor T. C. Chamberlin, of Beloit, the State Geologist, and Professors R. D. Irving and M. Strong, Assistant Geologists.

2. Including the Champlain and Terrace.

3. Including four sub-divisions in the southern part of the State and six in the northern, among which are the Racine and Guelph limestones.

4. The Clinton produces the Iron Ridge iron ore, the fossil ore of other States.

5. Including two sub-divisions in the lead region and four in southeastern Wisconsin.

6. The Calcliferous may include more than the Lower Magnesian.

7. Including several sub-divisions, among them the Madison sandstone and the Mendota limestone.

Chicago & North-Western Railroad—Cont.
 Ms. | via West Wisconsin Railroad.

212 Elroy.	2 b. Potsdam sandstone.
226 Camp Douglas.	"
227 Wis. Vall. Jun.	"
242 Lowery's.	"
244 Warren's.	"
249 Rudd's.	"
265 Blk River Falls.	{ 2 b. Potsdam sand- stone, resting on 1 Archaean Gneiss.
277 Merrillan.	2 b. Potsdam sandstone.
282 Humbird.	"
289 Fairchild.	"
299 Augusta.	"
309 Fall Creek.	"
321 Eau Claire.	"
323 West Eau Claire	"
332 Elk Mound.	"
339 Rusk.	"
344 Menomonee.	"
353 Knapp.	3 a. Lower Magnesian.
358 Wilson.	20. Quaternary.
361 Hersey.	"
369 Baldwin.	"
372 Hammond.	"
378 Roberts.	"
390 Hudson.	2 b. Potsdam.
394 Stillwater Junc.	(See Minnesota.)
410 St. Paul.	(See Minnesota.)

Kenosha and Rockford Division.

0 Kenosha.	20. Quaternary.
6 Pleasant Prairie	"
10 Woodworth.	"
12 Bristol.	"
15 Salem.	"
19 Fox River.	"
22 Bassett.	"
27 Genoa Junction.	"
44 Harvard Junction	(See Illinois.)
72 Rockford.	"

Minnesota Division.

0 Chicago.	(As before.)
212 Elroy.	2 b. Potsdam sandstone.
217 Glendale.	"
227 Wilton.	"
233 Norwalk.	"
246 Sparta.	"
255 Bangor.	"
260 Salem.	"
267 Winona Junc'n.	"
276 La Crosse.	"
267 Winona Junc'n.	"
269 Onalaska.	"
273 Midway.	"
278 Lytle.	"
284 Trempealeau.	"
292 Marshland.	"
297 Winona.	(See Minnesota.)

Chicago & North Western Railroad—Cont.
 Ms. | Milwaukee, Green Bay and Lake Superior
 Division.

0 Chicago.	(As before.)
45 State Line.	20. Quaternary.
51 Kenosha.	"
60 Racine Junc'n.	5 c. Niag. (Racine) l. s.
62 Racine.	"
70 County Line.	20. Quaternary.
75 Oak Creek.	"
81 St. Francis.	"
83 Elizabeth St.	"
85 Milwaukee.	{ 10. Hamilton, Milwau- kee Cement Rock. { 5 c. Niagara.
90 Lake Shore Junc	20. Quaternary
91 Lindworm.	"
100 Granville.	5 c. Niagara.
107 Germantown.	"
112 Jackson.	"
119 West Bend.	20. Moraine Drift.
120 Barton.	"
126 Kewaskum.	" 5 c. Niaga.
133 New Cassel.	"
140 Eden.	"
148 Fond du Lac.	4 b. Galena limestone. { 4 b. Galena l. s. { 4 a. Trenton l. s.
165 Oskosh.	"
178 Menasha and Neenah.	"
180 West Menasha.	"
185 Appleton.	{ 4 b. Galena l. s. { 4 a. Trenton l. s.
190 Little Chute.	4 b. Galena limestone.
192 Kaukauna.	"
198 Wrightstown.	"
208 De Pere.	"
214 Ft. Howard and Green Bay.	{ 4 c. Cincinnati shale. { 4 b. Galena l. s.
218 Duck Creek.	4 b. Galena limestone.
222 Big Suamico.	"
228 Little Suamico.	"
233 Brookside.	20. Quaternary. { 4 b. Galena l. s. { 4 a. Trenton l. s.
237 Pensaukee.	20. Quaternary.
242 Oconto.	"
252 Cavoits.	{ 4 b. Galena l. s. { 4 a. Trenton l. s.
256 Peshtigo.	4 b. Galena limestone.
263 Marinette.	"
264 Menomonee.	"
382 Escanaba, Mich.	(See Michigan.)
	(Continued in Michigan.)

Chicago, Milwaukee and St. Paul Railroad.
 Chicago, Milwaukee, La Crosse, St. Paul and
 Minneapolis Division.

0 Chicago.	(As before.)
43 Wadsworth.	20. Quaternary.
52 Kenosha Junc'n	"
53 Truesdell.	"
62 W. U. Junction	"

Chicago, Milwaukee and St. Paul Railroad.Chicago, Milwaukee, La Crosse, St. Paul and
Ms. | Minneapolis Division—*Continued.*

85 Milwaukee.	{ 10. Hamilton, Milwaukee Cement Rock. 5 c. Niagara l. s.
98 Brookfield.	20. Quaternary.
109 Pewaukee.	5 c. Niagara limestone.
109 Hartland.	20. Quaternary.
111 Nashotah.	"
116 Oconomowoc.	"
129 Watertown.	4 b. Galena limestone.
130 Watertown Jun.	"
139 Reeseville.	20. Quaternary.
144 Elba.	"
148 Columbus.	3 a. Lower Magn. l. s.
152 Fall River.	"
158 Doylestown.	"
163 Rio.	"
168 Wyocena.	{ 2 b. Mad. s.s. { in R. 2 b. Men. s.s. { R. cut
176 Portage City.	2 b. Potsdam s. s.
193 Kilbourn.	{ 2 b. Potsdam s. s., finely exposed in dalles of Wisc'n.
202 Lyndon.	2 b. Potsdam sandstone.
209 Lemonweir.	"
212 Mauston.	" large out-
220 Lisbon.	" liers.
225 Camp Douglas.	"
238 Tomah.	"
242 Greenfield.	"
249 Lafayette.	"
255 Sparta.	"
265 Bangor.	"
270 West Salem.	"
277 Winona Junc'n.	"
280 La Crosse.	"
410 St. Paul.	(See Minnesota.)
420 Minneapolis.	"

**Prairie du Chien, and Iowa and Minnesota
Division.**

0 Milwaukee.	{ 10. Hamilton, Milwaukee Cement Rock. 5 c. Niagara l. s.
6 Wauwatosa.	5 c. Niagara limestone.
10 Elm Grove.	20. Quaternary.
14 Brookfield Jun.	"
17 Forest House.	"
21 Waukesha.	5 c. Niagara limestone.
28 Genesee.	"
31 North Prairie.	20. Quaternary.
37 Eagle.	{ Kettle Range. 20. Moraine Drift.
42 Palmyra.	"
51 Whitewater.	4 b. Galena limestone.
56 Lima.	20. Quaternary.
62 Milton.	"
64 Milton Junction	"
71 Edgerton.	{ 4 a. Trenton. 3 c. St. Peter's s. s.

Chicago, Milwaukee and St. Paul Railroad.Prairie du Chien, and Iowa and Minnesota
Ms. | Division—*Continued.*

81 Stoughton.	20. Quaternary.
89 McFarland.	{ 20. Heavy Drift. 3 a. Lower Magn. l.s.
96 Madison.	{ 20. Moraine Drift. 3 a. Lower Magn. l.s.
102 Middleton.	{ 2 b. Madison s. s. 2 b. Mendota l. s. 2 b. Potsdam s. s. 3 a. Lower Magn. l.s. (capping bluffs.)
110 Cross Plains.	{ 2 b. Mad. s.s. { bluff 2 b. Men. l.s. { sides.
115 Black Earth.	2 b. Potsdam s.s. valley bottom.
119 Mazomanie.	"
125 Arena.	2 b. Potsdam sandstone.
132 Spring Green.	{ 3 a. Low. Magn., &c., on bluffs.
139 Lone Rock.	2 b. Potsdam s. s. on low ground.
145 Avoca.	2 b. Potsdam in the valley. Adjacent bluffs capped with
151 Muscoda.	3 a. Lower Magnesian limestone.
166 Boscobel.	"
176 Wauzeka.	3 a. Lower Magnesian.
183 Wright's Ferry.	"
186 Bridgeport.	"
194 Prairie du Chien	"
64 Milton Junction	20. Quaternary.
71 Janesville.	{ 4 a. Trenton l. s. 3 c. St. Peter's s. s.
78 Hanover.	4 a. Trenton limestone.
83 Orford.	{ 4 a. Trenton l. s. 3 c. St. Peter's s. s.
90 Brodhead.	"
106 Monroe.	4 b. Galena limestone.

Madison Division.

0 Madison.	3 a. Lower Magnesian.
12 Sun Prairie.	4 a. Trenton.
18 Deanville.	20. Quaternary.
20 Marshall.	"
23 Waterloo.	{ 4 a. Trenton l. s. 3 a. Lower Magn. l.s.
27 Hubbleton.	{ 1 a. Arch. Quartzite. 20. Quaternary.
37 Watertown Jun	4 b. Galena limestone.

Northern Division.

0 Milwaukee.	{ 10. Hamilton, Milwaukee Cement Rock. 5 c. Niagara l. s.
9 Schwartzburg.	"
15 Granville.	"
20 Germantown.	"
25 Richfield.	20. Quaternary.
33 Schleising'ville.	" Moraine.

Chicago, Milwaukee and St. Paul Railroad.**Ms. | Northern Division—Continued.**

37 Hartford.	{ 5 c. Niagara l. s. 5 b. Clinton iron ore. 4 c. Cincinnati shale.
41 Rubicon.	20. Quaternary.
46 Woodland.	"
47 Iron Ridge.	{ 5 c. Niagara l. s. 5 b. Clinton iron ore. 4 c. Cincinnati shale.
54 Horicon Junct'n.	20. Quaternary.
59 Burnett Junct'n.	"
68 Waupun.	4 b. Galena limestone.
76 Brandon.	20. Quaternary.
	{ 4 b. Galena l. s. 4 a. Trenton l. s. 3 c. St. Peter's s. s. 3 a. Lower Magn. l. s.
83 Ripon.	
	{ 3 a. Lower Magn. l. s. 2 b. Potsdam s. s. 1. Arch. Porphyry.
96 Berlin.	
90 Picket's.	4 a. Trenton limestone.
102 Oshkosh.	{ 4 b. Galena l. s. 4 a. Trenton l. s.
90 Rush Lake.	3 a. Lower Magn. l. s.
95 Waukau.	"
99 Omro.	20. Quaternary.
104 Winneconne.	"
54 Horicon Junct'n.	20. Quaternary.
57 Minnesota Jun.	"
59 Rolling Prairie.	"
63 Beaver Dam.	{ 4 b. Galena l. s. 4 a. Trenton l. s.
69 Fox Lake Jun.	4 a. Trenton limestone.
	{ 4 a. Trenton l. s. 3 c. St. Peter's s. s. 3 a. Lower Magn. l. s.
74 Randolph.	
	{ 3 a. Lower Magn. l. s. 2 b. Madison s. s. 2 b. Mendota l. s. 2 b. Potsdam s. s.
80 Cambria.	
90 Pardeeville.	2 b. Potsdam sandstone.
98 Portage City.	"

Madison and Portage Division.

0 Madison.	(As before.)
1 East Madison.	"
12 Windsor.	{ 3 a. Lower Magn. l. s. 2 b. Potsdam s. s.
16 Morrison.	3 a. Lower Magn. l. s.
21 Arlington.	{ 3 c. St. Peter's s. s. 3 a. Lower Magn. l. s.
25 Poynette.	2 b. Potsdam sandstone.
30 Portage.	"

Western Union Railroad.

0 Racine.	5 c. Niag. (Racine) l. s.
2 Junction.	"
8 W. U. Junction.	20. Quaternary.
10 Windsor.	"
15 Union Grove.	"

Ms. | Western Union Railroad—Continued.

18 Kansasville.	20. Quaternary.
27 Burlington.	5 c. Niagara limestone.
31 Lyons.	"
34 Springfield.	20. Quaternary.
41 Elkhorn.	"
46 Delavan.	"
50 Darien.	"
54 Allen's Grove.	"
59 Clinton.	"
	{ 4 b. Galena l. s. 4 a. Trenton l. s. 3 c. St. Peter's s. s.
69 Beloit.	
(Continued in Illinois.)	
0 Eagle.	20. Moraine Drift.
6 Troy Center.	"
9 Mayhew's.	20. Quaternary.
11 Fayette.	"
17 Elkhorn.	"

Sheboygan and Fond du Lac Railroad.

0 Sheboygan.	5 c. Niagara limestone.
5 Sheboygan Falls.	"
10 Town Line.	20. Quaternary.
14 Plymouth.	"
20 Glenbeulah.	{ Kettle Range. Moraine Drift.
	{ 5 c. Niagara l. s. 20. Quaternary.
26 St. Cloud.	
30 Calvary.	5 c. Niagara limestone.
43 Fond du Lac.	4 b. Galena limestone.
44 Fond du Lac Ju.	"
47 Woodhull.	20. Quaternary.
52 Eldorado.	"
55 Rosendale.	"
57 West Rosendale.	"
	{ 4 b. Galena l. s. 4 a. Trenton l. s. 3 c. St. Peter's s. s. 3 a. Lower Magn. l. s.
63 Ripon.	
	{ 4 a. Trenton l. s. 3 c. St. Peter's s. s. 3 a. Lower Magn. l. s.
69 Green Lake.	
	{ 4 a. Trenton l. s. 3 c. St. Peter's s. s. 3 a. Lower Magn. l. s.
72 St. Marie.	3 a. Lower Magn. l. s.
78 Princeton.	"

Green Bay and Minnesota Railroad.

0 Green Bay.	{ 5 c. Niagara l. s. 4 c. Cincinnati shale. 4 b. Galena l. s.
10 Oneida.	"
17 Seymour.	{ 4 a. Trenton l. s. 3 c. St. Peter's s. s.
23 Black Creek.	3 a. Lower Magn. l. s.
31 Shiocton.	20. Quaternary.
	{ 3 a. Lower Magn. l. s. 2 b. Potsdam s. s.
39 New London.	
46 Royalton.	20. Quaternary.
50 Manawa.	"
55 Ogdensburg.	"
61 Scandinavia.	"

Ms. | Green Bay & Minnesota R. R.—Cont.

78 Amherst.	{ 20. Heavy Drift.
82 Plover.	{ 2 b. Potsdam s. s.
	“
96 Grand Rapids.	{ 1. Archæan Gneiss,
	overlaid by
	{ 2 b. Potsdam s. s. and
	altering into Kaolin.
111 Dexterville.	2 b. Potsdam sandstone.
119 Scranton.	“
142 Hatfield.	“
149 Merrillan.	“
153 Alma Center.	“
159 Hixton.	“
166 Taylor.	“
172 Blair.	“
179 Whitehall.	“
193 Arcadia.	“
210 Marshland.	{ 2 b. Potsdam s. s.
214 Winona.	{ 3 a. Lower Magn. l. s.
	(See Minnesota.)

Milwaukee, Lake Shore and Western Railroad.

0 Milwaukee.	{ 10. Hamilton, Cement
	Rock.
4 Lake Shore Jun	{ 5 c. Niagara l. s.
6 White Fish Bay.	20. Quaternary.
10 Dillman's.	10. Hamilton.
13 Mequon.	20. Quaternary.
20 Ulao.	“
25 Port Washing'n	5 c. Niagara.
31 Decker's.	“
33 Belgium.	20. Quaternary.
38 Cedar Grove.	“
42 Oostburg.	“
46 Wilson.	“
48 Weeden's.	“
52 Sheboygan.	5 c. Niagara l. s.
58 Mosel.	20. Quaternary.
64 Centreville.	“
69 Newton.	“
77 Manitowoc.	5 c. Niagara l. s.
84 Branch.	20. Quaternary.
89 Cato.	5 c. Niagara.
91 Grimms.	“
94 Reedville.	“
100 Brillion.	“
104 Forest Junction	20. Quaternary.
108 Dundas.	“
113 Kaukauna.	4 b. Galena.
115 Little Chute.	“
120 Appleton.	{ 4 b. Galena l. s.
	{ 4 a. Trenton l. s.
77 Manitowoc.	20. Quaternary.
84 Two Rivers.	“

Wisconsin Central Railroad.

0 Milwaukee.	{ 10. Hamilton, Cement
	Rock.
	{ 5 c. Niagara l. s.

Ms. | Wisconsin Central R. R.—Continued.

Schwartzburg.	5 c. Niagara.
18 Thienville.	20. Quaternary.
23 Cedarburg.	5 c. Niagara l. s.
25 Grafton.	“
29 Saukville.	“
36 Fredonia.	“
41 Random.	20. Quaternary.
46 Sherman.	“
50 Waldo.	“
55 Plymouth.	“
62 Elkhart Lake.	{ 20. Quaternary.
	{ 20. Moraine.
	Kettle Range.
68 Kiel.	5 c. Niagara.
72 Holstein.	20. Quaternary.
Hayton.	“
79 Chilton.	“
86 Hilbert.	“
86 Hilbert.	20. Quaternary.
91 Forest Junction	“
Holland.	“
99 Greenleaf.	“
Ledgeville.	5 c. Niagara.
109 De Pere.	4 b. Galena.
	{ 5 c. Niagara l. s.
113 Green Bay.	{ 4 c. Cincinnati shale.
	{ 4 b. Galena l. s.
86 Hilbert.	20. Quaternary.
92 Sherwood.	5 c. Niagara l. s.
	{ 4 b. Galena l. s.
102 Menasha.	{ 4 a. Trenton l. s.
	3 a. Lower Magnesian.
113 Medina.	“
115 Dale.	“
129 Weyauwega.	2 b. Potsdam.
136 Waupaca.	1. Archæan.
Sheridan.	20. Quaternary.
150 Amherst.	“
165 Stevens' Point.	{ 2 b. Potsdam s. s. and
	{ 1. Archæan Gneiss.
176 Junction City.	1. Archæan.
Mill Creek.	“
Auburndale.	{ 1. Archæan, overlaid
	{ by heavy drift.
197 Marshfield.	“
Mannville.	“
206 Spencer.	“
212 Unity.	“
216 Colby.	“
228 Dorchester.	“
232 Medford.	“
244 Chelsen.	“
248 Westboro.	“
266 Worcester.	“
273 Phillips.	“
281 Wauboo.	“
287 Fifield.	“
297 Butternut Creek	“
309 Chippewa.	“
324 Penokee.*	1. Hur'n, with iron ore.
White River.	20. Quaternary.
351 Ashland.	“ on Lake Superior.

Ms. Wisconsin Central Railroad—Cont.		Ms. Mineral Point Railroad.	
165	Stevens' Point. (As before.)	0	Mineral Point. { 4 b. Galena l. s.
170	Plover. { 2 b. Potsdam, overlaid by drift.		{ 4 a. Trenton l. s.
176	Buena Vista. "		{ 3 c. St. Peter's s. s.
187	Plainfield. "	10	Calamine. { 4 b. Galena l. s.
193	Hancock. "		{ 4 a. Trenton l. s.
211	Westfield. "		{ 3 c. St. Peter's s. s.
220	Pachwaukee. "	20	Belmont. { 4 b. Galena limestone.
236	Portage. "	28	Platteville. { 4 b. Galena l. s.
			{ 4 a. Trenton l. s.
North Wisconsin Railroad.			
0	Clayton. 20. Drift.	0	Mineral Point. (As before.)
24	New Richmond. "	10	Calamine. { 4 b. Galena limestone.
39	North Wis. Jun. "	16	Darlington. { 4 a. Trenton limestone.
42	Hudson. 2 b. Potsdam s. s.	26	Gratiot. { 4 b. Galena l. s.
		33	Warren. { 4 a. Trenton l. s.
Wisconsin Valley Railroad.			(See Illinois.)
		Galena and South Wisconsin Railroad.	
0	Tomah. 2 b. Potsdam sandstone.	0	Galena, Ill. { 4 b. Galena limestone.
7	Valley Junction. "	7	Bell's. "
10	Norway. "	11	Gillett's. "
18	Beaver. "	15	Benton. "
29	Remington. "	20	St. Rose. "
42	Port Edwards. { 2 b. Potsdam s. s. on 1. Archæan Gneiss.	32	Platteville. { 4 b. Galena l. s.
46	Centralia. "		{ 4 a. Trenton l. s.
54	Rudolph. 1. Archæan.		
60	Junction City. "		
70	Knowlton. "		
76	Mosinee. "		
89	Wausau. " (lumber region.)		

* Unconformability between Huronian and Laurentian finely shown at Penokee.

NOTE.—Where several formations are given it is to be understood that they occur in the vicinity, not necessarily immediately at the station. Also, that where the drift effectually conceals the underlying formations, they are not usually given, though in almost all cases definitely known.

Minnesota. *

List of the Geological Formations found in Minnesota :

FORMATIONS PER GENERAL LIST.	MINNESOTA SUB-DIVISIONS.	FORMATIONS PER GENERAL LIST.	MINNESOTA SUB-DIVISIONS.
20. Quaternary.	20. Quater'y or drift.	4 a. Trenton.	4 b. Galena l. s.
18. Cretaceous.	18 b. Benton.	"	4 a. Trenton l. s.
"	18 a. Dakota.	3 a. Calciferous.	3 b. St. Peters s. s.
10. Hamilton.	10 a. Hamilton l. s.	"	3 a. Low Magnesian.*
9 c. Corniferous.	9 c. Corniferous.	2 b. Potsdam.	2 c. St. Croix s. s.
5 c. Niagara.	5 c. Niagara l. s.	"	2 b. Potsdam s. s.
4 c. Cincinnati.	4 c. Maquoketa sh.	1. Archæan.	1. Archæan.

*Sub-divided into 3 Shakopee l. s., 2 Jordan s. s., and 1 St. Lawrence l. s.

Ms. 1 Southern Minnesota R. R.	Ms. Winona and St. Peter's—Continued.
0 Milwaukee.	308 Stockton.
0 La Crescent.	316 Lewiston.
1 Gr'nd Crossing	319 Utica.
32 Rushford.	325 St. Charles.
37 Peterson.	329 Dover.
46 Whalan.	334 Eyota.
51 Lanesboro.	347 Rochester.
57 Isinours.	356 Byron.
62 Fountain.	362 Kasson.
70 Wykoff.	368 Dodge Centre.
77 Spring Valley.	375 Claremont.
86 Grand Meadow	382 Havana.
101 Brownsdale.	387 Owatonna.
106 RAMSAY.	396 Meriden.
113 Oakland.	402 Waseca.
122 Hayward.	413 Janesville.
128 Albert Lea.	428 Mankato Junc.
138 Alden.	" { St. Paul and
147 Wells.	" { Sioux city Jn
162 Delaware.	428 Mankato.
171 Winnebago.	437 St. Peters.
	446 Oshawa.
	467 New Ulm.
	545 Marshall.

Ms. 2 Winona & St. Peter's (C. & N. W.) R.R.	
297 Winona.	{ 2 b. Potsdam, and
303 Minnesota City	{ 3 a. Calcifr's in bluffs.
	"

*Prepared expressly for this work, by Prof. N. H. Winchell, of Minneapolis, the State Geologist of Minnesota.

1 The three sub-divisions of the Lower Magnesian : 1, St. Lawrence l. ; 2, Jordan s. s. ; and 3, Shakopee l. s. are here seen.

2 In the immediate river bluffs, are the Jordan and Shakopee. Further back are the St. Peter's and Trenton.

3 Overlying 3 a. Calciferous, i. e., its two upper members—the 2 Jordan sandstone and the 3 Shakopee limestone, seen in the bluffs.

3 St. Paul and Sioux City R. R.			Chicago, Milwaukee and St. Paul—Cont.		
Ms.			Ms.		
0 St. Paul.	{	3 b. St. Peter's, and 4 a. Trenton.	144 Owatonna.	{	4 a. Trenton, on river banks.
6 Mendota Junc.		"	150 Medford.	{	3 a. Calcif. Shakopee l.s.
11 Nicola.		"	159 Faribault.	{	4 a. Trenton.
19 Hamilton.	21	Quatern. drift bluffs.		{	3 a. St. Peter's.
29 Bloomington.		"	170 Dundas.	{	3 a. Calc. (Shakopee.)
28 Shakopee.	3 a.	Calcif's, Shakopee l.	173 Northfield.	{	3 a. Calcif's. and 4 a.
34 Merriam.		"		{	Trenton on high blfs.
39 Jordan.		" and Jordan s. s.	179 Castle Rock.	5	3 b. St. Peter's, s. s.
43 St. Lawrence.	{	3 a. Calciferous. St. Lawrence.	186 Farmington.		" and 4 a. Trn. near
	{	18 Cretaceous. Over	193 Rosemount.	4 a.	Tren. Heavy drift.
47 Belle Plaine.		3 a. Calciferous.	199 Westcott.		"
51 Blakeley.		"	206 St. Paul Junc.		"
58 E. Henderson.		"	212 St. PAUL.		" and 3 b. St. Pet.
62 Le Sueur.	{	3 a. Calciferous, Shak- opee l. s. Jordan s.s.	(La Crosse and St. Paul Division.)		
69 Ottawa.		"	306 Winona.	{	3 a. Calciferous, Bluffs
75 St. Peter.		"		{	2 b. Potsdam.
77 Kasota.		"	313 Minnesota City		"
86 Mankato.		" 18 cret. over	323 Minneiska.		"
89 South Bend.		"	326 Weaver.		"
91 Minneopa. ⁴		"	333 Kellogg.		"
99 Lake Crystal.	18	Cretac's. Heavy drift	340 Wabasha.		"
109 Madelia.		"	342 Read's Land'g.		"
116 Lincoln.		"	352 Lake City.		"
122 St. James.		"	359 Frontenac.		"
137 Mountain Lake		"	369 Red Wing.		"
148 Windom.		"	390 Hastings.		"
154 Wilder.		"	396 Langdon.		"
160 Heron Lake.		"	401 Newport.		"
170 Hersey.		"	409 St. Paul.	{	4 a. Trenton.
178 Worthington.		"		{	3 b. St. Peters.
			Ft. Snelling.		"
			Minnehaha.		"
			424 MINNEAPOLIS. ⁶		"
4 Hastings and Dakota R. R.			6 Minneapolis and St. Louis R. R.		
Ms.			Ms.		
0 Hastings.	3 a.	Calciferous bluffs.	0 Minneapolis. ⁶	{	4 a. Trenton.
8 Vermillion.		"		{	3 c. St. Peter's s.s.
12 Auburn.		"	21 Chaska.	3 a.	Calciferous.
18 Farmington.	3 b.	St. Peter's s. s.	23 Carver.		"
22 Fairfield.		" or 4 a. Trenton	26 Sioux City Jun		"
33 Prior Lake.		"	7 St. Paul and Pacific R. R.		
41 Shakopee.	3 a.	Shakopee l. s.	0 St. Paul.	{	4 a. Trenton.
65 Chaska.	3 a.	Calcif's. heavy drift		{	3 c. St. Peter's s. s.
48 Carver.		"	10 St. Anthony.		"
74 Glencoe.	18	Cretaceous. "	11 Minneapolis.		"
5 Chicago, Milwaukee and St. Paul R. R.			25 Wayzata.	18	Cretaceous. ?
(Iowa and Minnesota Division.)			28 Long Lake.		"
0 N. McGregor.	See	Iowa.	33 Maple Plain.		"
85 Le Roy.	10	Hamilton.	35 Armstrong.		"
96 Adams.		"	43 Delano.	2.	Primordial. ?
111 Austin.	18	Cretaceous.	49 Waverly.		"
114 Ramsey.		"	54 Howard Lake.		"
117 Lansing.		"	57 Smith Lake.		"
126 Blo'm'g Prairie		"	61 Cokato.	1.	Metamorph. probably
135 Aurora.		"			

4 The cascade at Minneopa Falls, 30 feet high, is caused by the Jordan sandstone. This R. R. crosses the gorge $\frac{1}{2}$ mile below the fall.

5 The outlier of the St. Peter's s. s. 70 feet high, visible from the Station toward the east, gives the name to the place.

6 The Falls of St. Anthony, at Minneapolis, are caused by the rapid wearing out of the very friable St. Peter's sandstone under the Trenton limestone, leaving a projecting shelf of the latter.

Heavy drift.

Iowa.*

LIST OF THE GEOLOGICAL FORMATIONS FOUND IN IOWA :

20. Bluff Deposit, Post Tertiary.	10 b. Hamilton.
20. Glacial Drift.	5 c. Niagara.
18 a. Lower Cretaceous.	4 c. Cincinnati.
14 c. Upper Coal Measures.	4 b. Galena Limestone.
14 b. Low. Coal Mrs. (producing Coal.)	4 a. Trenton.
14 a. Millstone Grit.	3 b. St. Peter's Sandstone.
13 b. Upper Sub-Carboniferous.	3 a. Lower Magnesian Limestone.
13 a. Lower Sub-Carboniferous.	2 b. Potsdam.

Chicago, Milwaukee and St. Paul Railroad.		Chicago, Milwaukee & St. Paul R. R.—Con.	
Prairie du Chien, and Iowa and Minnesota Division.		Ms. Mason City and Austin Division.	
Ms.		0 Mason City.	10 b. Hamilton.
0 North McGregor	{ 3 b. St. Peter's s.s. in hills; 2 b. Potsdam, 3 a. L. Magnesian.	8 Plymouth.	"
6 Giard.	3 a. Lower Magnesian.	21 Carpenter.	"
15 Monona.	4 a. Trenton.	28 Lyle.	"
19 Luana.	"	40 Austin, Minn.	18. Cretaceous.
26 Postville.	"	Illinois Central Railroad. Iowa Division.	
32 Castalia.	"		
37 Ossian.	"	0 Dubuque.	4 b. Galena limestone.
43 Calmar.	"	10 Julien.	"
46 Conover.	"	15 Peosta.	"
53 Ridgeway.	"	23 Farley.	5 c. Niagara.
62 Cresco.	5 c. Niagara.	29 Dyersville.	"
73 Lime Springs.	"	37 Earlville.	"
78 Chester.	"	41 Delaware.	"
85 Le Roy.	"	47 Manchester.	"
(See Minnesota, 5.)		54 Masonville.	"
Iowa and Dakota Division.		61 Winthrop.	10 b. Hamilton.
0 Calmar.	4 a. Trenton.	69 Independence.	"
6 Fort Atkinson.	"	78 Jesup.	"
18 Lawler.	5 c. Niagara.	86 Raymond.	"
27 New Hampton.	10 b. Hamilton.	93 Waterloo.	"
35 Chickasaw.	"	98 Jn. C.F. & M. RR.	"
38 Bassett.	"	99 Cedar Falls.	"
47 Charles City.	"	109 New Hartford.	"
50 Floyd.	"	118 Parkersburg.	"
59 Rudd.	"	123 Aplington.	13 a. Low. Sub-Carbon.
64 Nora Springs.	"	132 Ackley.	"
74 Mason City.	"	143 Iowa Falls.	"
84 Clear Lake.	20. Glacial Drift.	149 Alden.	"
95 Garner.	"	158 Williams.	"
105 Britt.	"	172 Webster City.	{ " & 14 b. L. Coal Mrs.
115 Wesley.	"	192 Fort Dodge.	"
126 Algonia.	"	210 Manson.	20. Glacial Drift.

* Prepared by Dr. C. A. White, late State Geologist of Iowa.

Illinois Central Railroad.		Chicago and North-Western Railroad.	
Ms.	Iowa Division—Continued.	Ms.	Iowa Midland Division—Continued.
218 Pomeroy.	20. Glacial Drift.	50 Monmouth.	5 c. Niagara.
226 Fonda.	"	57 Onslow.	"
235 Newell.	"	64 Amber.	"
245 Storm Lake.	"	71 Anamosa.	"
258 Aurelia.	"	Omaha and California Division.	
268 Cherokee.	"	0 Chicago.	(As before.)
283 Marcus.	"	138 Clinton.	5 c. Niagara.
291 Remsen.	"	143 Camanche.	"
302 Le Mars.	"	147 Low Moor.	"
319 James'.	20. Bluff Deposit.	152 Malone.	"
327 Sioux City.	18 a. Lower Cretaceous.	157 De Witt.	"
Cedar Falls and Minnesota Branch.		163 Grand Mound.	"
0 Waterloo.	10 b. Hamilton.	169 Calamus.	"
12 Janesville.	"	173 Wheatland.	"
18 Waverly.	"	178 Loudon.	"
27 Plainfield.	"	185 Clarence.	"
35 Nashua.	"	190 Stanwood.	"
44 Charles City.	"	195 Mechanicsville.	"
52 Floyd.	"	202 Lisbon.	10 b. Hamilton.
63 Osage.	"	203 Mount Vernon.	"
67 West Mitchell.	"	210 Bertram.	"
72 St. Ansgar.	"	219 Cedar Rapids.	"
80 Mona.	"	227 Fairfax.	"
Dubuque and South-Western Railroad.		234 Norway.	"
0 Farley.	5 c. Niagara.	244 Blairstown.	"
7 Worthington.	"	249 Luzerne.	"
14 Sand Spring.	"	254 Belle Plaine.	"
20 Monticello.	"	260 Chelsea.	"
24 Langworthy.	"	270 Tama.	13 a. Low. Sub-Carbon.
31 Anamosa.	"	277 Montour.	"
38 Viola.	"	280 Le Grand.	"
42 Springville.	"	283 Quarry.	"
50 Marion.	10 b. Hamilton.	288 Marshall.	"
56 Cedar Rapids.	"	296 Lamoille.	"
Western Union Railroad.		303 State Centre.	14 b. Lower Coal Mrs.
Sabula, Ackley and Dakota Division.		310 Colo.	"
0 Sabula.	5 c. Niagara.	317 Nevada.	"
6 Elk River.	"	326 Ames.	"
15 Miles.	"	330 Ontario.	"
20 Preston.	"	335 Midway.	"
28 Riggs.	"	340 Boone.	"
33 Delmar Junct'n.	"	346 Moingona.	"
40 Elwood.	"	352 Ogden.	"
52 Oxford Junct'n.	"	357 Beaver.	"
62 Olin.	"	363 Grand Junction.	"
74 Martelle.	"	370 New Jefferson.	"
79 Paralta.	10 b. Hamilton.	379 Scranton.	"
87 Marion.	"	388 Glidden.	20. Glacial Drift.
Chicago and North-Western Railroad.		396 Carroll.	"
Iowa Midland Division.		406 Arcadia.	"
0 Clinton.	5 c. Niagara.	408 West Side.	"
3 Lyons.	"	415 Vail.	"
10 Almont.	"	424 Denison.	"
17 Bryant.	"	433 Dowville.	"
25 Charlotte.	"	441 Dunlap.	"
33 Delmar Junct'n.	"	450 Woodbine.	"
38 Maquoketa.	"	458 Logan.	14 c. Upper Coal Mrs.
44 Nashville.	"	467 Mo. Valley Jun.	"
47 Baldwin.	"	482 Crescent.	{ and 20. Bluff Deposit.
		488 Council Bluffs.	"

Ms. Chicago, Rock Island and Pacific R. R.		Chicago, Rock Island & Pacific Railroad.	
0 Chicago.	(As before.)	Ms. Indianola and Somerset Branch—Con.	
183 Davenport.	{ 14 c. Up. Coal Mrs. and 20. Bluff Deposit.	15 Somerset Junc.	14 b. Lower Coal Mrs.
195 Walcott.	"	18 Somerset.	"
199 Fulton.	"	21 Indianola.	"
208 Wilton.	"	15 Somerset Junc.	"
211 Moscow.	"	21 Spring Hill.	"
216 Atalissa.	"	25 Lathrop.	14 c. Upper Coal Mrs.
221 West Liberty.	"	30 Bevington.	"
227 Downey.	"	34 Patterson.	"
237 Iowa City.	"	42 Winterset.	"
252 Oxford.	"	Oskaloosa Branch.	
257 Homestead.	"	0 Washington.	13 b. Upper Sub-Carb.
267 Marengo.	"	15 Keota.	"
277 Victor.	"	20 Harper.	"
287 Brooklyn.	{ 14 a., (equivalent to Millstone Grit).	28 Sigourney.	{ & 14 b. L. Coal Mrs.
293 Malcolm.	"	36 Delta.	13 b. Upper Sub-Carb.
302 Grinnell.	"	43 Rose Hill.	14 b. Lower Coal Mrs.
313 Kellogg.	"	52 Oskaloosa.	"
322 Newton.	14 b. Lower Coal Mrs.	Chicago, Burlington and Quincy Railroad.	
334 Colfax.	"	Iowa Division.	
340 Mitchellsville.	"	0 Burlington.	13 a. Lower Sub-Carb.
357 Des Moines.	"	9 Middletown.	13 b. Upper Sub-Carb.
372 Booneville.	14 c. Upper Coal Mrs.	13 Danville.	"
379 De Soto.	"	19 New London.	"
392 Dexter.	"	28 Mount Pleasant.	"
397 Stuart.	"	35 Rome.	" and 13 a.
403 Guthrie.	"	42 Glendale.	14 b. Lower Coal Mrs.
408 Casey.	"	50 Fairfield.	"
415 Adair.	"	55 Whitfield.	"
422 Anita.	"	62 Batavia.	"
436 Atlantic.	"	69 Agency.	"
455 Avoca.	"	75 Ottumwa.	" and 13 b.
463 Shelby.	"	83 Chillicothe.	"
474 Neola.	"	91 Frederic.	"
490 Council Bluffs.	{ and 20. Bluff Deposit.	100 Albia.	"
South-Western Division.		108 Tyrone.	"
208 Wilton.	10 b. Hamilton.	114 Melrose.	"
220 Muscatine.	"	122 Russell.	"
233 Ononwa.	13 a. Lower Sub-Carb.	130 Chariton.	14 c. Upper Coal Mrs.
240 Fredonia.	"	146 Woodburn.	"
242 Columbus Junc.	"	156 Osceola.	"
252 Ainsworth.	"	166 Murray.	"
258 Washington.	"	180 Afton.	"
271 Brighton.	13 b. Upper Sub-Carb.	190 Creston.	"
286 Fairfield.	14 b. Lower Coal Mrs.	195 Cromwell.	"
292 Libertyville.	"	211 Corning.	"
304 Eldon.	"	215 Brooks.	"
317 Belknap.	"	225 Villisca.	"
333 Unionville.	"	233 Stanton.	"
345 Centerville.	"	241 Red Oak.	" and 13 a.
360 Seymour.	"	255 Hastings.	{ 20. Bluff Deposit, (Post Tertiary.)
(Continued in Missouri.)		261 Malvern.	"
Indianola and Winterset Branch.		271 Glenwood.	14 c. Upper Coal Mrs.
0 Des Moines.	14 b. Lower Coal Mrs.	275 Pacific Junc'tn.	20. Quaternary.
8 Avon.	"	279 E. Plattsmouth.	"
10 Carlisle.	"		

Chicago, Burlington & Quincy R. R.—Con.

Ms.	Branch.
130 Chariton.	14 c. Upper Coal Mres.
141 Derby.	"
147 Humiston.	"
154 Garden Grove.	"
Leon.	"

Branch.

190 Creston.	14 c. Upper Coal Mres.
207 Lenox.	"
225 Bedford.	"
234 Hopkins.	"

Branch.

241 Red Oak.	14 c. U. Cl. Mrs. & 18 a.
254 Essex.	20. Quat. or Post Ter'y.
259 Shenandoah.	"
266 Farragut.	"
271 Riverton.	"
280 Hamburg.	"
291 Nebraska City.	"

Burlington and South-Western Railroad.

0 Burlington.	13 a. Lower Sub-Carb.
19 Fort Madison.	"
25 Viele.	"
31 Franklin.	"
33 Donaldson.	13 b. Upper Sub-Carb.
36 Warren.	"
44 Farmington.	" and 14 a.
50 Willits.	14 b. Lower Coal Mres.
55 Mount Sterling.	"
63 Cantril.	"
69 Milton.	"
75 Pulaski.	"
85 Bloomfield.	"
99 Moulton.	"
108 Caldwell.	"
113 Cincinnati.	"
118 Mendota.	"
122 Howland.	"
128 Unionville, Mo.	"
(Continued in Missouri.)	

Missouri, Iowa and Nebraska Railroad.

0 Centreville.	14 b. Lower Coal Mres.
7 Sedan.	"
11 Dean.	"
15 Hamilton.	"
(Continued in Missouri.)	

Sioux City and St. Paul Railroad.

0 Sioux City.	18 a. Lower Cretaceous.
8 James.	{ 20. Bluff Deposit,
	{ (Post Tertiary.)
25 Le Mars.	20. Glacial Drift.
30 Seney.	"
42 East Orange.	"
50 Hospers.	"
58 Sheldon.	"
67 St. Gilman.	"
74 Sibley.	"
92 Worthington.	(See Minnesota, 3.)

Dakota Southern Railroad.

0 Sioux City.	18 a. Lower Cretaceous.
8 McCook.	"
13 Jefferson.	18 b. Middle Cretaceous.
14 Davis Junction.	"
21 Elk Point.	"
30 Burbank.	"
34 Vermillion.	"
44 Meckling.	"
50 Gayville.	"
55 James River.	"
61 Yankton.	"
14 Davis Junction.	"
19 Joy.	"
24 Westfield.	"
29 Portlandville.	"

Sioux City and Pacific Railroad.

0 Sioux City.	18 a. Lower Cretaceous.
9 Sergeant's Bluffs.	"
22 Sloan.	20. Quaternary.
38 Onawa.	"
53 River Sioux.	"
60 Mondamin.	"
66 Modale.	"
71 California June.	"
77 Missouri Valley.	"

Kansas City, St. Joseph & Council Bluffs.

1 Council Bluffs.	14 c. and 20. Bluff Dep.
6 Traders' Point.	20. Quaternary.
14 Pacific.	"
17 Pacific Junction.	"
20 Haney's.	"
25 Bartlett.	"
30 McPaul.	"
34 Percival.	"
40 E. Nebras. City.	"
51 Hamburg.	"

(Continued in Missouri.)

Des Moines and Fort Dodge Railroad.

0 Des Moines.	14 b. Lower Coal Mres.
8 Ashewa.	"
15 Waukee.	"
21 Dallas Centre.	"
27 Minburn.	"
34 Perry.	"
42 Rippey.	"
50 Grand Junction.	"
59 Paton.	"
67 Gowrie.	"
73 Nesho.	"
82 Tara.	"
88 Fort Dodge.	" and 13 b.

Des Moines and Minneapolis Railroad.

0 Des Moines.	14 b. Lower Coal Mres.
7 Saylor.	"
8 Trent.	"
11 Ankeny.	"
14 Pelton.	"
18 Polk City.	"
21 Ulm.	"
25 Sheldahl.	"
31 Kelley.	"
37 Ames.	"

Central Railroad of Iowa.		Burlington, Cedar Rapids and Northern Railroad—Continued.	
Ms.		Ms.	
0 St. Louis.	13 a. Lower Sub-Carb.	97 Cedar Rapids.	10 b. Hamilton.
176 Keokuk.	13 b. and 14 b.	101 Linn.	"
253 Ottumwa.	"	107 Palo.	"
269 Eddyville.	14 b. L. Coal Measures.	111 Shellsburg.	"
278 Oskaloosa.	"	120 Vinton.	"
291 New Sharon.	"	128 Mount Auburn.	"
299 Searsboro.	14 a. Millstone Grit.	134 La Porte.	"
311 Grinnell.	"	150 Waterloo.	"
322 Gilman.	13 a. Lower Sub-Carb.	156 Cedar Falls.	"
336 Marshalltown.	"	160 Norris.	"
343 Albion.	"	164 Finchford.	"
349 Liscomb.	"	171 Shell Rock.	"
354 Union.	"	178 Clarksville.	"
363 Eldora.	14 b. L. Coal Measures.	189 Greene.	"
367 Steamboat Rock	13 a. Lower Sub-Carb.	195 Marble Rock.	"
374 Abbott.	"	202 Rockford.	"
379 Ackley.	"	210 Nora Junction.	"
384 Franklin.	"	215 Rock Falls.	"
389 Geneva.	"	219 Plymouth.	"
395 Hampton.	"	250 Lyle.	"
404 Chapin.	"	261 Austin.	"
412 Rockwell.	"		
424 Mason City.	10 b. Hamilton.		
Keokuk and Des Moines Valley Railroad.		Milwaukee Division.	
0 Des Moines.	14 b. L. Coal Measures.	0 Cedar Rapids.	10 b. Hamilton.
24 Prairie City.	"	4 Linn.	"
35 Monroe.	"	18 Center Point.	"
47 Pella.	13 b. Upper Sub-Carb.	25 Walker.	"
62 Oskaloosa.	14 b. L. Coal Measures.	39 Independence.	"
71 Eddyville.	" and 13 b.	53 Oelwein.	"
86 Ottumwa.	"	60 Maynard.	"
98 Eldon.	"	69 Donnan.	"
116 Summit.	"	74 West Union.	5 c. Niagara.
123 Bentonsport.	13 b. Upper Sub-Carb.	81 Elgin.	4 a. Trenton.
126 Bonaparte.	"	89 Clermont.	"
132 Farmington.	" and 14 b.	98 Postville.	"
137 Croton.	"		
147 Sand Prairie.	"	Muscatine Division.	
162 Keokuk.	13 a. Lower Sub-Carb.	0 Muscatine.	10 b. Hamilton.
Burlington, Cedar Rapids & Northern R. R.		11 Cedar River.	"
0 Burlington.	13 a. Lower Sub-Carb.	13 Adams.	"
9 Latty.	"	16 Nichols.	"
12 Sperry.	"	23 Lone Tree.	"
15 Kossuth.	"	26 River Junction.	"
20 Linton.	"	31 Riverside.	"
23 Morning Sun.	"	Pacific Division.	
29 Wapello.	"	0 Cedar Rapids.	10 b. Hamilton.
35 Long Creek.	"	1 Epley.	"
41 Columbus Junc.	"	4 Linn.	"
44 Port Allen.	"	9 Palo.	"
47 Cone.	10 b. Hamilton.	14 Shellsburg.	"
55 Nichols.	"	22 Vinton.	"
61 West Liberty.	"	29 Benton.	"
67 Centredale.	"	39 Dysart.	"
70 West Branch.	"	48 Traer.	"
73 Oasis.	"	Davenport and North-Western Railroad.	
77 Morse.	"	0 Davenport.	10 b. Hamilton.
82 Solon.	"	5 Mount Joy.	"
89 Ely.	"	8 Eldridge.	"

Davenport and North-Western Railroad— Ms. <i>Continued.</i>		Chicago, Dubuque & Minnesota and Chicago, Ms. Dubuque & Clinton Railroads.	
17 Donahue.	10 b. Hamilton.	178 La Crosse.	(See Wisconsin.)
23 Dixon.	"	183 New Albin.	{ 2 b. Potsdam & 3 a. L. Magnesian l. s.
32 Wheatland.	5 c. Niagara.	141 Lansing.	"
37 Toronto.	"	126 Harper's Ferry.	"
40 Massillon.	"	118 Yellow River.	"
46 Oxford Mills.	"	115 North McGregor.	"
53 Wyoming.	"	104 Clayton.	3 a. L. Mag. limestone.
69 Monticello.	"	95 Guttenberg.	{ 4 a. Trenton and 4 b. Galena limestone.
77 Hopkinton.	"	88 Turkey River.	4 a. Trenton.
85 Delhi.	"	84 Buena Vista.	"
89 Delaware.	"	80 Waupeton.	"
94 Greeley.	"	72 Specht's Ferry.	"
99 Edgewood.	"	Peru.	"
106 Enfield.	"	60 Dubuque.	4 b. Galena limestone.
115 Brush Creek.	"	54 Massey.	"
125 Fayette.	"	46 Gordon's Ferry.	"
11 Eldridge.	10 b. Hamilton.	38 Bellevue.	4 c. Cincinnati.
14 Long Grove.	5 c. Niagara.	28 Green Island.	5 c. Niagara.
C. & N.W. Cro'g	"	18 Sabula.	"
24 De Witt.	"	2 Lyons.	"
31 Welton.	"	0 Clinton.	"
37 Delmar Junct'n.	"	Turkey River Branch.	
44 Maquoketa.	"	88 Turkey River.	4 a. Trenton.
		108 Elkport.	"
		111 Littlefort.	"
		125 Volga City.	"
		138 Lima.	"

Missouri.¹

GEOLOGICAL FORMATIONS OF MISSOURI.

20. Quaternary, Alluvium, Bluff or Loess, and Drift.	5-7. Upper Silurian, 7. L. Helderberg.
19. Tertiary, in Southeast Missouri.	" " 5. Niagara.
18. Cretaceous, " "	2-4. Lower Silurian, 4 c. Cincinnati.
14. Coal Measures, 14 c. Upper.	" " 4 b. Galena or Receptaculite l. s.
" " 14 b. Middle.	" " 4 a. Trenton and Black River.
" " 14 a. Lower.	" " " { 1st Magnesian Saccharoidal s. s.
13. L. Carboniferous or Sub-Carb., 13 e. Chester group.	" " " { 2d Magnesian l. s.
" " 13 d. St. Louis.	" " " { 2d Sandstone.
" " 13 c. Keokuk.	" " " { 3d Magnesian l. s.
" " 13 b. Burlington.	" " " { Lower Magnesian l. s. and s. s.
" " 13 a. Kinderhook or Chouteau.	" " " { 2 b. Potsdam.
10. Devonian, 10 c. Black Slate (Genesee ?)	1 b. Huronian.
5-7. Upper Silurian, 8. Oriskany.	1 a. Laurentian.

Ms. | Hannibal and St. Joseph Railroad.

0 Hannibal.	13 a. & b. Sub-Carbonifer's
6 Bear Creek.	" & 20. Quat.
10 Barkley.	" "
15 Palmyra Junc'n	" "
19 Woodland.	" "
30 Monroe.	14 b. Coal Measures.
42 Lakenan.	" "
53 Lentner.	" "
59 Clarence.	20. overlies 13 c.
70 Macon.	14 b. Coal Measures.
79 Callao.	" 4 ft. coal.
90 Lingo.	" "
104 Brookfield.	" "
109 Laclede.	" "
121 Wheeling.	14 b. Middle Coal Mrs.
130 Chillicothe.	" "
140 Mooresville.	14 c. Upper Coal Mrs.
150 Nettleton.	" "
156 Hamilton.	" "
163 Kidder.	" "
172 Cameron Junc'n	" "
177 Osborn.	" "
185 Stewartsville.	" "
200 Saxton.	" "
206 St. Joseph.	{ " and hills cov'd with Bluff clay.

Ms. | Hannibal and St. Joseph R.R.—Cont.

0 Quincy.	13 a. Sub-Carbonifer's.
9 North River.	13 b. "
15 Palmyra.	" "
206 St. Joseph.	14 c. Upper Coal Mrs.
211 Lake.	20. Alluvial.
217 Halls.	" "
222 Rushville.	" & 14 c. U.C.M.
226 Winthrop.	" "
172 Cameron Junc'n	14 c. Upper Coal Mrs.
187 Lathrop.	" "
201 Kearney.	" "
211 Liberty.	" "
218 Arnold.	" "
226 Kansas City.	" "

St. Louis, Kansas City & Northern R.R.²

0 St. Louis.	13 d. St. Louis group.
6 Bartmer.	14 b. Middle Coal Mrs.
14 Graham's.	" [by 20.
22 St. Charles.	13 d. St. Lo. group, cov'd
30 Dardenne.	20. Quaternary.
38 Ferruque.	13 c. and d.
48 Foristell.	13 a. & b. rests on 10 c.
58 Warrenton.	" "
68 Jonesburg.	13 a. and 4 a. Trenton.
77 New Florence.	13 a.

1. By Professor G. C. Broadhead, late State Geologist of Missouri.

2. On St. L., K. C. & N. R. R., in Warren and Montgomery counties, we pass within a few miles from Carboniferous, chiefly Lower part of Sub-Carboniferous through thin outliers of Devonian to the Receptaculite (Galena limestone) and Trenton and Black River to the 1st Magnesian limestone and Saccharoidal sandstone; the latter well developed and very suitable for glass-making purposes—thick deposits and easy to crush. It is the equivalent of the St. Peter's sandstone.

St. Louis, Kansas City and Northern Railroad—Continued.		St. Louis, Kansas City and Northern Railroad—Continued.	
Ms.		Ms.	Columbia Branch.
0 Wellsville.	14 a. Lower Coal Mrs.	0 Centralia.	14 a. Lower Coal Mrs.
103 Benton City.	"	22 Columbia.	14 a. and 13 b. & c.
108 Mexico.	"	Glasgow Branch.	
114 Thompson.	"	0 Salisbury.	14 a. Lower Coal Mrs.
122 Centralia.	"	15 Glasgow.	" base.
130 Sturgeon.	"	Missouri, Iowa and Nebraska Railroad.	
140 Renick.	" 4 ft. coal.	0 Alexandria.	20. Alluvium.
146 Moberly.	"	7 Wayland.	13 d. St. Louis l. s.
153 Huntsville.	" 4 ft. coal.	15 Kahoka.	14 a. Coal Measures.
160 Clifton.	"	24 Luray.	"
167 Salisbury.	"	32 Arbela.	"
178 Dalton.	"	40 Memphis.	"
185 Brunswick.	"	51 Downing.	"
192 Dewitt.	" [quarry.	61 Lancaster.	"
195 Miami.	" white s. s.	64 Glenwood.	"
202 Wakenda.	20. Quaternary.	70 Hamilton.	"
209 Carrollton.	14 b. Middle Coal Mrs.	Quincy, Missouri and Pacific Railroad.	
219 Norborne.	20. Quaternary.	2 West Quincy.	20. Quaternary.
228 Hardin.	"	11 Maywood.	13 a. Sub-Carbonifer's.
234 Lexington Jun.	14 b. Coal, middle ser.	22 Tolona.	"
239 Camden.	"	32 La Belle.	"
245 Orrick.	20. Quaternary.	47 Edina.	13 d. Overlaid by drift.
254 Missouri City.	14 c. base of U. Cl. Ms.	54 Hurdland.	Deep drift.
265 N. Missouri Jun.	"	70 Kirksville.	14 a. Lower Coal Mrs.
273 Harlem.	20. Quaternary.	Missouri Pacific Railroad. ⁴	
275 Kansas City. ^a	14 c. Upper Coal Mrs.	0 St. Louis.	{ 13 d. St. Louis l. s. & 14 a. Coal Measures.
Northern Division,		7 Benton.	13 d. St. Louis l. s.
146 Moberly.	14 a. Lower Coal Mrs.	13 Kirkwood.	"
153 Cairo.	"	19 Meramec.	13 b. Sub-Carbonifer's.
162 Emerson.	"	26 Glencoe.	4 a. Trenton.
169 Macon.	"	30 Eureka.	"
180 Atlanta.	"	37 Pacific.	3 a. Calif. & 4 a. Tren.
189 La Plata.	"	41 Gray's Summit.	" 1st sandstone.
196 Millard.	"	52 South Point.	" 2d Magn. l. s.
203 Kirksville.	14 a. and b. "	54 Washington.	"
211 Sublett's.	"	67 Miller's Landing.	" " with
218 Queen City.	14 a. "	75 Berger.	" " cap. s. s.
227 Glenwood.	"	81 Hermann.	"
234 Coatesville.	"	88 Gasconade.	"
St. Joseph Division.		92 Morrison.	"
0 Lexington Jun.	14 b. Middle Coal Mrs.	100 Chamois.	"
9 Swanwick.	14 c. Base of upp. coal.	105 St. Aubert.	"
19 Vibbard.	14 c. Upper Coal Mrs.	125 Jefferson City.	"
25 Lawson.	"	140 Centretown.	lead, " 2d sandstone.
36 Lathrop.	"	150 California.	" 2d Magnes'n.
44 Plattsburg.	"	162 Tipton.	" On hills some-
53 Gower.	"	175 Otterville.	lead, " times find 13 b.
62 Agency Ford.	"		" Bur'n l. s. & 3 a.
73 St. Joseph.	"		

3. Loess is well developed at Kansas City.

4. On Missouri Pacific R. R., from St. Louis west, we pass St. Louis group, Lower Coal Measures, St. Louis group Warsaw limestone, Burlington and Chouteau group to the Trenton, but no Devonian. At Hermann we have 2d Magnesian limestone capped in hills back with 1st or Saccharoidal sandstone, and at Jefferson we have 2d Magnesian limestone rising in a few miles south exposing in succession 2d sandstone and 3d Magnesian limestone. West of Tipton the same limestone (2d) is capped by Burlington limestone. The latter west of Sedalia having reposing on it the sandstone at top of Sub-Carboniferous (Millstone Grit?) and underlain by Chouteau group. Then the Coal Measures appear.

Ms. | Missouri Pacific Railroad—Continued.

188 Sedalia.	13 a. & b. Burlington l.s.
195 Dresden.	" & 13 a. & 14 a.
200 Lamonte.	14 a. Lower Coal Mrs.
208 Knobnoster.	" iron ore & coal ms.
218 Warrensburg.	" fine s. s. quarries.
230 Holden.	14 b. Coal Measures.
237 Kingsville.	14 b. & c. U. Coal Mrs.
248 Pleasant Hill.	"
259 Lee's Summit.	"
272 Independence.	"
282 Kansas City.	"

Booneville Branch.

0 Tipton.	13 b. resting on 8 a.
14 Palestine.	13 a. Kinderhook.
25 Booneville.	13 c. & 14 a. Coal Mrs.

Lexington Branch.

0 Sedalia.	13 a. Sub-Carbonifer's.
4 Georgetown.	" 13 a., b. & c. S-C.
22 Brownsville.	13 b. Upper Sub-Carb.
38 Aullville.	14 b. Coal Measures.
55 Lexington.	" coal mines.

**Chicago, Rock Island and Pacific Railroad.
South-Western Division.**

0 Leavenworth.	14 c. Upper Coal Mrs.
5 Beverly.	"
11 Platte City.	"
21 Atchison Junc.	"
29 Grayson.	"
36 Plattsburg.	"
47 Perrin.	"
55 Cameron.	"
65 Winston.	"
76 Gallatin.	Base of "
86 Jamesport.	"
102 Trenton.	"
127 Princeton.	"
143 Lineville.	" Middle
156 Allerton.	" series in
169 Seymour.	" valleys.

(Continued in Iowa.)

Missouri, Kansas and Texas Railroad.

0 Hannibal.	13 a. & b. Sub-Carbon's.
12 Rensalier.	"
22 Monroe.	14 a. Lower Coal Mrs.
34 Stoutsville.	13 b. Sub-Carbonifer's.
44 Paris. ⁵	"
57 Madison.	13 c. & d. and 14 a.
70 Moberly.	"
80 Higbee.	" 4 ft. coal

**Missouri, Kansas and Texas Railroad—
Continued.**

88 Burton.	14 b. Coal Measures.
95 Fayette.	"
99 Talbott.	"
108 Boonville.	" & 13. c U.S-C.
122 Harris.	13 b. Upper Sub-Carb.
131 Clifton.	13 a. Sub-Carbonifer's.
143 Sedalia.	"
155 Green Ridge.	13 b. Upper Sub-Carb.
164 Windsor.	14 a. Coal Mrs. 4 ft. coal.
172 Calhoun.	" iron ore.
183 Clinton.	{ " coal mines, fos- sil ferns, &c.
196 Montrose.	"
202 Appleton City.	" " 4 ft. cl.
210 Rockville.	"
215 Schell City.	"
226 Walker.	"
233 Nevada.	"

(Continued in Kansas.)

Osage Division.

0 Holden.	14 b. Middle Coal Mrs.
8 Benton.	"
16 East Lynn.	14 b. Coal Measures.
22 Harrisonville.	14 c. Upper Coal Mrs.

**Chicago and Alton Railroad.
Chicago, Kansas City and Denver Line.**

275 Louisiana.	13 a. & b. & 10 c. & 4 c.
282 Watson.	" Cinn.
286 Bowling Green.	{ " good stone for buildg.
293 Curryville.	13 c. Sub-Carbonifer's.
302 Vandalia.	"
311 Laddonia.	14 a. Middle Coal Mrs.
320 Littleby.	"
325 Mexico.	"

Chicago and Jefferson Division.

0 Chicago.	
325 Mexico.	14 a. Middle Coal Mrs.
334 Bryans.	"
337 Auxvasse.	"
345 Callaway.	"
350 Fulton.	14 a., 3 b. and 10 c.
357 Carrington.	"
364 New Bloomfield.	"
370 Hibernia.	10 c. and 3 a.
376 Jefferson City.	3 a. Calciferous.

5. Archimedes in limestone.

6. On St. Louis & San Francisco R. R., going southwest, after leaving Pacific (or Franklin) the 2d Magnesian limestone gradually rises, showing some 2d sandstone, and through Crawford, Phelps and Pulaski counties the latter is the highest rock, resting on 3d magnesian limestone, the latter well exposed along the Gasconade River. Crossing it, we are upon the highest lands in Missouri. Descending towards Springfield, we find the Lower members of the Sub-Carboniferous limestone resting on the 2d Magnesian limestone or Calciferous. In southern parts of Lawrence county we find a coarse ferruginous sandstone, probably equivalent to Milletone Grit, but more probably a member of the Chester group, resting on Lower Carboniferous limestone. Throughout Newton and Jasper, the Sub-Carboniferous limestone, with much chert is of great development, and is galeniferous. The celebrated lead mines of Joplin and Granby occur in this.

St. Louis and San Francisco, or Atlantic and Pacific Railroad. ⁶			St. Louis, Iron Mountain and Southern Ms. Railroad—Continued.		
0 St. Louis.	20. & 13 d. St. L. l. s.		51 Blackwell.	3 a. Calciferous.	
37 Pacific.	4 a. Tren. & 3 a. Calcif.		57 Cadet.	" lead mine.	
44 Calvey.	3 a. Calciferous.		61 Mineral Point.	" many lead ms.	
49 Moselle.	"		65 Potosi.	" "	
56 St. Clair.	"	Occasional lead & iron mines.	66 Hopewell.	" "	
66 Stanton.	"		70 Irondale.	"	
78 Bourbon.	"		75 Bismarck.		
91 Cuba.	"		83 Loughborough.	2 b. Potsd. & 1 b. Hur.	
104 St. James.	" iron.		87 De Lassus.	" [quarry.	
114 Rolla.	" iron.		95 Knob Lick.	" & granite	
124 Ozark.	"			" lead, nickel,	
138 Dixon.	"		102 Mine la Motte.	{ cobalt, manganese,	
144 Hancock.	" iron.			{ copper and iron.	
150 Crocker.	"		105 Fredericktown.	2 b. Potsd. & 1 b. Hur.	
163 Richland.	"		112 Cornwall.	{ 2 b., 1 b. & 3 a. Calc.	
171 Stoutland.	"			{ iron and granite.	
178 Sleeper.	"		118 Marquand.	3 a. Calciferous, iron.	
185 Lebanon.	"		125 Bessville.	"	
			134 Lutesville.	"	
217 Marshfield.	{ 1498 feet above sea ; highest point in Mo.		148 Allenville.	"	
241 Springfield.	13 b. Sub-Carbonifer's.		158 Sylvania.	"	
266 Logan's.	"		162 Morley.	{ 20. Quaternary, with probably 19. Tertiary.	
278 Verona.	" and c.		174 Diehlstadi.	"	
291 Peirce City.	"		178 Charleston.	"	
306 Granby City.	{ 13 c. Keokuk l. s. (Lead abounds.)		195 Belmont.	"	
314 Neosho.	13 c. Keokuk l. s.				
325 Dayton.	"				
330 Seneca. ⁷	"				
(State Line.)	850 feet above tide.				
364 Vinita.	(See Kansas.)				
St. Louis, Iron Mountain & Southern R. R. ⁶			Arkansas Division.		
0 St. Louis.	13 d. St. Louis l. s.		76 Bismarck.	3 a. Calciferous.	
10 Jefferson Bar'ks	13 d. Warsaw l. s.		81 Iron Mountain. ⁹	{ 2 b. Pots. & 1 b. Hur. Specular iron ore in vast quantities.	
13 Cliff Cave.	13 c. Keokuk l. s.		86 Pilot Knob. ¹⁰	"	
21 Kimmswick.	13 b. Burlington l. s.		88 Ironton. ¹¹	2 b. Potsd. & 1 b. Hur.	
24 Sulphur Springs	"		89 Arcadia.	"	
27 Pevely.	4 a. Trenton.		96 Hogan.	"	
29 Horine. ⁸	{ 3 a. Calcif., sandy lead mine 6 miles north.		104 Ozark.	"	
35 Hematite.	3 a. Calciferous.		108 Annapolis.	"	
39 Victoria.	"		116 Des Arc.	"	
	" Valli lead		127 Piedmont.	"	
43 De Soto.	{ mines 10 miles south. Frumet lead mines. 10 miles north.		134 Mill Spring.	3 a. Calciferous.	
			145 Williamsville.	"	
			148 Blums.	"	
			166 Poplar Bluff.	" & 20. Quat.	
			186 Moark.		

(Continued in Arkansas.)

6. Down the St. Louis & Iron Mountain R. R. we have St. Louis limestone, then Warsaw limestone, Keokuk limestone and Burlington limestone within 20 miles. Crossing the Merrimac River, we find the last for a while, then the Receptaculite, Trenton and Black River limestone, 1st Magnesian limestone, and at Horine Station the Saccharoidal sandstone, very soft, used for glass-making, and is very white and pure. Afterwards we have 2d Magnesian limestone. Crossing Big River, the 3d Magnesian limestone near Iron Mountain. De Lassus, Mine la Motte, Fredericktown, Pilot Knob, Des Arc and Annapolis are porphyry hills of Huronian age, and the adjacent limestones and lower sandstones and conglomerates are probably Potsdam. At Mine la Motte and Fredericktown are certainly Potsdam fossils, but the absolute line (if any) has not been determined between the Potsdam and Calciferous beds. Near Iron Mountain, Knob Lick and Cornwall are superior granite quarries, which may be of age of Laurentian.

7. Polishing stone.

St. Louis, Iron Mountain and Southern Railroad—Continued.		Kansas City, St. Joseph and Council Bluffs Railroad.	
Ms.	Cairo Division.	Ms.	Chicago Branch—Continued.
0 Cairo.	{ Low lands. 20. Quat. and probably 19. Tertiary.	101 Barnard.	14 c. Upper Carbonifer.
10 Hough's.	"	108 Bridgewater.	"
15 Charleston.	"	115 Maryville.	"
28 Sikeston.	"	123 Pickering.	"
74 Poplar Bluff.	"	131 Hopkins.	"
St. Louis, Lawrence and Western R. R.		Burlington and South-Western Railroad.	
0 Pleasant Hill.	14 c. Upper Coal Mres.	0 Laclede.	14 b. Middle Coal Mres.
12 Raymore.	"	7 Linneus. ¹³	"
17 Belton.	"	20 Browning.	"
25 Stanley.	(See Kansas.)	32 Milan.	14 c. Upper Carbonifer.
Kansas City, St. Joseph and Council Bluffs Railroad.		37 Boynton.	14 b. Middle Coal Mres.
0 Kansas City.	{ 14 Upper Carbonifer. Good fossil mollusca.	45 Pollock.	"
10 Parkville.	14 c. Upper Carbonifer.	53 Unionville.	14 a. Lower Coal Mres.
17 Waldron.	"	181 Burlington.	(Continued in Iowa.)
25 E. Leavenworth.	"	St. Louis, Keokuk & North-Western R. R.	
34 Weston.	"	0 Keokuk.	13 c. Keokuk l. s.
54 Winthrop.	"	3 Alexandria.	"
55 Rushville.	"	11 Gregory.	"
66 Lake Station.	20. Quaternary.	22 Canton.	"
70 St. Joseph.	14 c. Upper Carbonifer.	28 La Grange.	20. Quaternary.
80 Amazonia.	" fusulina abounds	40 Quincy.	13 b. & c. Keokuk l. s.
99 Forest City.	" "& mollusca.	54 Helton.	"
109 Bigelow.	20. Quaternary.	60 Hannibal.	13 b. Sub-Carbonifer's.
116 Craig.	" over 14 c.	66 Saverton. ¹⁴	13 a. & b. " & 4 c. Cinn.
122 Corning.	"	75 Ashburn.	4 c. Cincinnati.
135 Phelps.	"	85 Louisiana.	{ 4 c., 10 c. and 13 a. & b. Sulphur Springs.
149 Hamburg.	" & 14 c. U. C.	St. Louis, Salem & Little Rock Railroad.	
200 Council Bluffs.	(Continued in Iowa.)	0 Cuba.	3 a. Calciferous.
Chicago Branch.		9 Steelville.	"
70 St. Joseph.	14 c. Upper Carbonifer.	16 Keysville.	"
79 Amazonia. ¹⁵	"	24 Cook's.	"
85 Savannah.	"	35 Howe's.	"
91 Rosendale.	"	40 Salem.	"
		41 Iron Hill.	"
		46 Orchard Bank.	"

8. Four miles southeast is Crystal City on the Mississippi River, where glass is made. The Saccharoidal or St. Peter's sandstone is here forty or fifty feet thick, and over one hundred feet thick in Warren County. It is very valuable for glass-making.

9. Iron Mountain is 228 feet high, and its base covers 500 acres.

10. Pilot Knob is a conical hill, nearly circular, 581 feet high, with a north and south diameter of about one mile at its base, which covers 360 acres.

11. Sheppard Mountain magnetic iron ore.

12. Red shales and fusulina.

13. Iron ores and paint clays.

14. Salt sulphur spring.

Lead & iron mines.

Kansas.*

The only geological formations found in Kansas are:

- | | | |
|--------------------------------------|--|---|
| 18. Cretaceous,
" "
" " | c. Niobrara group.
b. Fort Hays group.
a. Dakota group. | 15. Permian.
14 c. Upper Carboniferous.
14 b. Coal Measures. |
|--------------------------------------|--|---|

Ms. 1 St. Joseph and Denver City.		Ms. 4 Atchison, Topeka and Santa Fe.	
St. Joseph.	14 c. Upper Carbonifer's	1 Kansas City.	14 c. Upper Carbonifer's
0 Elwood.	" "	28 De Soto.	" "
5 Wathena.	" "	40 Lawrence.	" "
18 Troy.	" "	50 Leecompton.	" "
14 A. & N. R. J'n.	" "	62 Tecumseh.	" "
18 Norway.	" "	66 Topeka.	" "
42 Hiawatha.	" "	0 Atchison.	" "
50 Hamlin.	" "	16 Nortonville.	" "
60 Sabetha.	" "	26 Valley Falls.	" "
77 Seneca.	" "	35 Rock Creek.	" "
112 Marysville.	" "	51 Topeka.	" "
127 Hanover.	18. Cretaceous.	68 Carbondale.	" Coal Mines.
136 Hollenbury.	" "	72 Scranton.	14 b. Coal Measures.
138 State Line.	" "	77 Burlingame.	" "
141 Steele City, Neb.	(See Nebraska.)	85 Osage City.	" "
152 Fairbury.	" "	92 Arvonia.	" "
226 Hastings.	" "	97 Reading.	14 c. Upper Carbonifer's
268 Kearney Junc.	" "	112 Emporia.	" "
2 Atchison and Nebraska.		132 Cottonwood.	" "
0 Atchison.	14 c. Upper Carbonifer's	138 Elmdale.	" "
6 Doniphan.	" "	157 Florence.	" "
13 Brenner.	" "	168 Peabody.	" "
St. Joseph.	" "	178 Walton.	" "
17 Troy Junction.	" "	185 Newton.	" "
25 Highland.	" "	195 Halstead.	" "
31 Iowa Point.	" "	204 Burrton.	" "
36 White Cloud.	" "	218 Hutchinson.	18. Cretaceous.
38 State Line.	(Continued in Nebraska.)	237 Sterling.	" "
3 Central Branch Union Pacific.		260 Ellinwood.	" "
0 Atchison.	14 c. Upper Carbonifer's	270 Great Bend.	" "
15 Monrovia.	" "	283 Pawnee Rock.	" "
18 Effingham.	" "	292 Larned.	" "
25 Muscotah.	" "	300 Garfield.	" "
31 Whiting.	" "	316 Kinsley.	" "
37 Netawaha.	" "	353 Dodge City.	" "
42 Wetmore.	" "	454 Syracuse.	" "
62 Centralia.	" "	468 Sargent.	" "
70 Vermilion.	" "	481 Granada, Col.	(See Colorado.)
78 Frankfort.	" "	532 Las Animas.	" "
81 Barretts.	" "	618 Pueblo.	" "
91 Irving.	" "	(Wichita Branch.)	
95 Blue Rapids.	" "	185 Newton.	14 c. Upper Carbonifer's
100 Waterville.	" "	195 Sedgwick City.	" "
		212 Wichita.	" "

*Revised and corrected by Prof. B. F. Mudge, late State Geologist of Kansas.

Ms. 5 Wathena and Doniphan.		Ms. Kansas Pacific—Continued.	
0 Wathena.	14 c. Upper Carbonifer's	289 Hays.	18 Creta's. b. Ft. Hays.
13 Doniphan.	" "	302 Ellis.	18 Creta's. c. Niobrara.
6 Kansas Central.		312 Ogallah.	" "
0 Leavenworth.	14 c. Upper Carbonifer's	322 Trego.	Chalk. " "
11 Pleasant Ridge	" "	336 Cayote.	" "
16 Easton.	" "	364 Grinnell.	" "
25 Winchester.	" "	376 Carlyle.	" "
36 Valley Falls.	" "	385 Monument.	" "
48 Carbon.	" "	397 Gophen.	" "
56 Holton.	" "	405 Sheridan.	" "
7 Missouri Pacific. 44 ms.		420 Wallace.	" Nos. 3 and 4.
0 St. Louis.	14 c. Upper Carbonifer's	429 Eagle Tail, Col.	(See Colorado.)
282 Kansas City.	" "	440 Monotony.	Lignitic Group.
284 State Line.	" "	487 Kit Carson.	" "
286 Wyandotte.	" "	534 Hugo.	" "
295 Pomeroy.	" "	583 Deer Tail.	" "
309 Leavenworth.*	" "	638 Denver.	" "
312 Ft. Leavenworth	" "	740 Cheyenne.	19 White River Tertiary.
330 Atchison.	" "		
8 Southern Kansas.		10 Junction City and Fort Kearney Branch.	
0 Cherryvale.	14 b. Coal Measures.	138 Junction City.	15. Permian.
10 Independence.	" "	151 Milford.	" "
		157 Wakefield.	" "
		171 Clay Center.	" "
9 Kansas Pacific.		Arkansas Valley Branch, (Colorado.)	
Kansas City.	14 c. Upper Carbonifer's	487 Kit Carson.	Lignitic Group.
0 State Line.	" "	496 Rush Creek.	" "
13 Edwardsville.	" "	511 Salt Springs.	" "
27 Stranger.	" "	533 Well No. 1.	18 Cretaci's, Nos. 3 & 4.
38 Lawrence.	" "	540 Fort Lyon.	" "
0 Leavenworth.	" "	543 Las Animas.	" "
21 Tonganoxie.	" "		
26 Reno.	" "	11 Missouri, Kansas and Texas.	
34 Lawrence.	" "	(Neosho Division.)	
38 Lawrence.	" "	0 Parsons.	14 b. Coal Measures.
51 Perryville.	" "	5 Ladore.	" "
52 Medina.	" "	26 Chanute.	" "
60 Grantville.	" "	35 Humboldt.	" "
67 Topeka.	" "	50 Neosho Falls.	" "
77 Silver Lake.	" "	56 Le Roy.	" "
83 Rossville.	" "	67 Burlington.	" "
90 St. Marys.	" "	81 Hartford.	" "
97 Belvue.	" "	88 Neosho Rapids.	14 c. Upper Carbonifer's
104 Wamego.	" "	95 Emporia.	" "
110 St. George.	" "	104 Americus.	" "
118 Manhattan.	15. Permian.	112 Rock City.	" "
129 Ogden.	" "	120 Council Grove.	" "
135 Fort Riley.	" "	132 Parkerville.	15. Permian.
138 Junction City.	" "	137 White City.	" "
144 Kansas Falls.	" "	143 Skiddy.	" "
157 Detroit.	" "	156 Junction City.	" "
163 Abilene.	" "		
172 Solomon.	18. Cretac's. a. Dakota.	0 Sedalia, Mo.	" "
185 Salina.	" "	111 Fort Scott.	14 b. Coal Measures.
200 Brookville.	" "	118 Marmaton.	" "
210 Elm Creek.	" "	131 Hepler.	" "
223 Ellsworth.	" "	137 Walnut.	" "
252 Bunker Hill.	18 Cretac's. b. Ft. Hays.	145 Osage Mission.	" "
279 Victoria.	" "	151 South Mound.	" "

*Coal mined through a shaft 710 feet deep.

Missouri, Kansas and Texas. Neosho Division—Continued.			13 Leavenworth, Lawrence and Galveston.	
Ms.			0 Kansas City.	14 c. Upper Carbonifer's
0 PARSONS.	14 b. Coal Measures.	Coal Mines.	21 Olathe.	" "
9 Labette.	" "		30 Gardner.	" "
14 Oswego.	" "		35 Edgerton.	" "
24 Chetopa.	" "		41 Wellsville.	" "
40 Bl'e Jacket, I.T	" "		46 Le Loup.	" "
53 Vinita.	" "		53 K.C. & S. F. J'n	" "
(Osage Division.)			0 Lawrence.	14 b. Coal Measures.
0 Holden, Mo.	14 c. Upper Carbonifer's		15 Baldwin City.	" "
22 Harrisonville.	" "		23 Coal Siding.	" "
31 Freeman.	" "		26 K.C. & S. F. J'n	" "
35 West Line.	" "		27 Ottawa.	(Coal Mines.)*
41 Louisburg.	" "		36 Princeton.	14 b. Coal Measures.
46 Somerset.	" "		51 Garnett.	" "
53 Paola, Ka.	" "		78 Iola.	" "
12 Missouri River, Fort Scott and Gulf.			86 Humboldt.	" "
0 Kansas City.	14 c. Upper Carbonifer's	Coal Mining Region.	92 Neosho.	" "
9 Shawnee.	" "		94 Chanute.	" "
14 Lenexa.	" "		108 Thayer.	" "
21 Olathe.	" "		124 Cherryvale.	" "
28 Ocheltree.	" "		134 Independence.	" "
30 Spring Hill.	" "		133 Liberty.	" "
36 Hillsdale.	" "		138 Kalloch.	" "
43 Paola.	" "		140 Coffeyville.	" "
54 Fontana.	14 b. Coal Measures.		144 Parker.	" "
61 Les Cygnes.	" "		14 St. Louis, Lawrence and Western.	
67 Barnard.	" "		0 Pleas't Hill, Mo.	- - - - -
74 Pleasanton.	" "		25 Stanley, Ka.	14 c. Upper Carbonifer's
82 Prescott.	" "		34 Olathe.	" "
86 Osage.	" "		48 De Soto.	" "
98 Fort Scott.	" "		54 Eudora.	" "
111 Pawnee.	" "		61 Lawrence.	" "
124 Girard.	" "		69 Sigel.	" "
135 Cherokee.	" "		80 Richland.	" "
141 Coalfield.	" "		92 Summit.	" "
148 Columbus.	" "		93 Carbondale.	" "
153 Neutral.	" "			
159 Baxter.	" "			

*For a full description of the coal fields of Kansas and the other States, see "THE COAL REGIONS OF AMERICA—their Topography, Geology and Development—with numerous Maps and Illustrations." By James Macfarlane. Published and sold by D. Appleton & Co., New York. 8vo. pp. 700. Price, \$5.00. Sent by mail, postage paid.

Colorado.*

List of the Geological Formations in Colorado:

- | | |
|---|--|
| 19. Tertiary.
Lignitic Group (producing coal.)
18. Cretaceous, Nos. 2, 3, 4 and 5. | 17. Jurassic.
16. Triassic.
1. Archæan. (Gold and Silver Mines) |
|---|--|

Ms.	1 Kansas Pacific R. R. and Branches.	Ms.	Denver and Boulder Valley—Con.
420	Wallace, Kan.	41	White Rk Mills Lignitic Group.
429	Eagle Tail, Col.	43	Valmont. "
440	Monotony.	45	C. C. Junction "
462	Arapahoe.	46	Boulder. { Immediately at Boulder City, Nos. 4 & 5.
452	Cheyenne Wells		
472	First View.		
487	Kit Carson.		
499	Wild Horse.		
511	Aroya.		
523	Mirage.		
534	Hugo.		
562	Cedar Point.		
566	Godfrey.		
572	Agate.		
588	Deer Tail.		
595	Byer's.		
617	Box Elder.		
629	Schuyler.		
636	Den. Pac. Jun.		
638	Denver.		
740	Cheyenne.		
	See Denv. to Cheyenne.		
2 Arkansas Valley Branch.			
0	Kit Carson.		
2	Sand Creek.		
5	Bent's R. Cros.		
9	Rush Creek.		
24	Salt Springs.		
46	Well No. 1.		
53	Fort Lyon.		
56	Las Animas.		
	La Junta.		
3 Denver and Pacific R. R.			
0	Denver.		
14	Henderson Isl.		
19	Hughes'.		
	Fort Lupton.		
32	Johnson.		
47	Evans.		
52	Greeley.		
65	Pierce.		
85	Carr.		
96	Summit Siding.		
106	Cheyenne.		
4 Denver and Boulder Valley.			
0	Denver.		
2	Junction.		
19	Hughes.		
34	Eric.		
5 Denver and Rio Grande R. R.			
0	Denver.		
10	Littleton.		
17	Acequia.		
25	Plum.		
33	Castle Rock.		
39	Glade.		
43	Larkspur.		
47	Greenland.		
52	Divide.		
58	Monument.		
67	Borstville.		
75	Colorado Sp'gs		
83	Widefield.		
87	Fountain.		
94	Little Buttes.		
106	Pinon.		
118	Pueblo.		
120	South Pueblo.		
129	San Carlos.		
133	Greenhorn.		
146	Graneros.		
156	Huerfano.		
169	Cucharas.		
189	Apishapa.		
198	Chicosa.		
206	El Moro.		
120	South Pueblo.		
125	Goodnight.		
129	Meadows.		
134	Swallows.		
141	Carlisle Sp'ngs.		
153	Beaver Creek.		
155	Labran.		
160	Canon City.		
169	Cucharas.		
176	Walsenburg.		
183	North Veta.		
191	La Veta.		
6 Denver, South Park and Pacific R. R.			
0	Denver.		
16	Morrison.		

*Prepared for this work by Professor F. V. Hayden, United States Geologist.

7 Colorado Central Railroad.		Ms. Colorado Central Railroad—Continued.	
0 Denver-	Lignitic Group.	18 Floyd's Hill.	1. Archæan.
4 Summit.	"	(Stages.)	"
8 Arvada.	"	33 Georgetown.	"
14 Golden Junc.	"	16 Cottonwood.	1. Archæan.
16 Golden.	"	17 Smith's Hill.	"
0 Golden.	Lignitic Group.	21 Black Hawk.	"
2 Golden Junc.	"	(Stages.)	"
5 Ralston.	"	23 Central City.	"
20 Coal Creek.	"	8 Pueblo and Arkansas Valley R. R.	
27 Davidson.	"	0 Grenada.	18. Cretac's. Nos. 3 & 4.
28 Boulder.	"	18 Blackwell.	"
36 Ni-wot.	18. Cretaceous No. 5.	34 Caddoa.	"
41 Longmont.	"	50 Las Animas.	"
0 Golden.	{ Crosses. 18. Cretac's.	54 W. Las Animas	"
	{ 17. Juras. & Red beds.	63 Robinson.	"
3 Chimney Gulch	1. Archæan.	72 La Junta.	"
6 Guy Gulch.	"	83 Rocky Ford.	"
8 Beaver Brook.	"	95 Apishpa.	"
9 Elk Creek.	"	108 Nepiesta.	"
13 Big Hill.	"	123 Chico.	"
14 Forks Creek.	"	136 Pueblo.	"

NOTE.—Along the Colorado or front range of mountains, there are many objects and places of interest; Pike's Peak (1. Archæan.) over 14,000 feet above sea level, which can be ascended on horseback, by a good road, to the summit; the Soda Springs, at Manitou; the Garden of the Gods, with the unique weathered forms of red (17. Jurassic or 16. Triassic) sandstone; and Monument Park, with modern (19.) Tertiary-capped pillars or columns. Along the railroad from Cheyenne to Trinidad, the lofty snow-clad mountain peaks are, many of them over 14,000 feet high, as Long's Peak, James', Arapahoe, Torrey's and Gray's, Evans', Sierra Blanca, Spanish Peak, and many others.

See notes on page 165.

F. V. H.

Nebraska.*

Ms. Atchison and Nebraska Railroad.		Burlington and Missouri River Railroad.	
0 Lincoln.	14. Upper Carbonifer's.	0 Plattsmouth.	14. Carb's Up. Cl. Mres.
9 Salttillo.	14. Carbon. Coal Mres.?	4 Oreapolis.	"
22 Firth.	"	9 Concord.	"
36 Sterling.	"	19 Louisville.	"
49 Tecumseh.	"	31 Ashland.	"
63 Table Rock.	"	43 Waverly.	"
72 Humboldt.	"	55 Lincoln.	14. Upper Carbonifer's.
86 Salem.	"	65 Denton.	"
92 Falls City.	"	75 Crete.	18. Cret. Dakota Group.
111 White Cloud.	"	92 Friendville.	"
(Continued in Kansas.)		108 Fairmont.	"

* By Prof. F. V. Hayden, United States Geologist.

Burlington and Missouri River Railroad— Ms. Continued.		Ms. Union Pacific Railroad.	
123 Sutton.	18. Cretaceous ?	0 Omaha.	14. Carb. Up. Cl. Mres.
136 Harvard.	" ?	10 Gilmore.	"
151 Hastings.	19. White River Tert'y.	21 Millard.	"
166 Kenesaw.	"	31 Waterloo.	"
176 Lowell.	"	47 Fremont.	18. Cret. Dakota Group.
182 Fort Kearney.	"	54 Ames.	"
191 Kearney Junc'n.	"	69 Rogers.	"
Nebraska Railroad.		84 Richland.	"
0 Brownville.	14. Carbon. Coal Mres.	99 Jackson.	"
8 Peru.	"	109 Silver Creek.	"
22 Nebraska City.	"	121 Clark's.	19. White River Tert'y.
33 Dunbar.	"	132 Lone Tree.	"
45 Syracuse.	"	142 Chapman's.	"
56 Palmyra.	"	154 Grand Island.	"
70 Cheney's.	" ?	162 Alda.	"
80 Lincoln.	14. Upper Carbonifer's.	170 Wood River.	"
98 Germantown.	18. Cretaceous ?	183 Gibbon.	"
105 Seward.	" ?	195 Kearney Junc'n	"
Omaha and North-Western Railroad.		204 Stevenson.	"
0 Omaha.	14. Carbon. Coal Mres.	212 Elm Creek.	"
6 Florence.	"	221 Overton.	"
12 Warner.	"	231 Plum Creek.	"
21 Calhoun.	"	239 Cayote.	"
24 Mills.	"	250 Willow Island.	"
26 De Soto.	"	260 Warren.	"
30 Blair.	"	268 Brady Island.	"
40 Herman.	18. Cretaceous.	277 McPherson.	"
Sioux City and Pacific Railroad.		291 North Platte.	"
0 Wisner.	18. Cretaceous.	299 Nichols.	"
15 West Point.	"	315 Dexter.	"
23 Crowell.	"	332 Roscoe.	"
35 Hooper.	"	342 Ogalalla.	"
50 Fremont.	"	357 Brule.	"
59 Bell Creek.	"	361 Big Spring.	"
68 Kennard.	14. Carbon. Coal Mres.	387 Chappel.	"
75 Blair.	"	396 Lodge Pole.	"
St. Joseph and Denver City Railroad.		406 Colton.	"
0 Kearney Junc'n.	19. White River Tert'y.	414 Sidney.	"
40 Hastings.	" ?	423 Brownson.	"
48 Glenville.	18. Cretaceous ?	433 Potter.	"
58 Fairfield.	"	443 Bennett.	"
66 Edgar.	"	451 Antelope.	"
75 Davenport.	"	463 Bushnell.	"
83 Carleton.	"	473 Pine Bluffs.	"
90 Belvidere.	" ?	479 Tracy.	"
99 Alexandria.	14. Upper Carbonifer's.	484 Egbert.	"
114 Fairbury.	14. Carbon. Coal Mres.	496 Hillsdale.	"
124 Steele City.	"	503 Atkins.	"
		508 Archer.	"
		516 Cheyenne.	(See Wyoming.)

Notes on Geological Observations in Colorado and Utah.

FURNISHED FOR THIS WORK, BY W. M. DAVIS, JR., OF PHILADELPHIA.

COLORADO.

Denver & Rio Grande Railroad.—1. Colorado Springs. View includes a stretch of the Front or Colorado Range of the Rocky Mountains. From north to west, unnamed. West, are Pike's Peak and Cameron's Cove. Southwest, are Mount Rosa and Cheyenne Mountains; the latter is the finest point of the view. All these are *granite*, or granitic porphyry, &c. Northeast, (3 miles), is Austin's Bluff, Tertiary. Southeast, (2 miles), is Mt. Washington, named after the highest of the White Mountains, whose height it closely equals, without rising conspicuously above the plain. West and northwest, are the hogbacks of Mesozoic rocks, standing about vertical—the result of the granitic upheaval. The Garden of the Gods, Glen Eyrie and Blair Athol are among these hogbacks to northwest. The Garden Gate is very conspicuous from the mesa (of drift?) west of the town. In Glen Eyrie (private residence of Gen'l Palmer) contact of Triassic sandstone and granite well seen. West, Ute Pass, to north of Pike's Peak, over to South Park. (Stage to Fairplay, two days.) The Fontaine qui Bouille comes down from this pass, past the town of Manitou at its foot—is joined by Monument Creek, outside of the hogbacks, and flows south to the Arkansas River.

Excursions (ponies \$3.00 a day) on the Plains, to Austin's Bluffs, Mt. Washington (half day), toward the mountains to Manitou and the fossiliferous Paleozoic rocks beyond, (their only exposure on Front Range 1)—to Garden of Gods, Glen Eyrie, Blair Athol, Cheyenne Canon, (this latter in granite). Each half a day—better a day. To the mountains, "Cheyenne Mountain:" a good (toll) carriage-road leads up valley back of this mountain. The ascent of a characteristic granite peak can be made from end of road (carriage or saddle) in a day.

To Pike's Peak, (pony \$6.00), two days, starting at 10 A. M. easily make Lake House by 4 or 5 o'clock. Good little shanty hotel. Moraine Lake shows good example of old glacial work. Leaving lake at 2 A. M., trail can easily be followed in dark to summit, in three hours, for sunrise. Signal Service station on top. View of Plains, Front Range, South Park (to west), and Arkansas Valley beyond; Sangre de Cristo, Sawatch ranges in southwest and south, with Blanca Peak (14,480 feet highest of Rocky Mountains in United States) at left end of Sangre de Cristo. Mountains Harvard (next highest), Yale and Princeton, to west; Mount Lincoln, and Gray's and Torrey's Peaks, northwest, and many others. Descent to Colorado Springs, 6 or 8 hours. With plenty of time—three days—I should make this trip on foot.

2. Edgerton (Borerville?) station for Monument Park. Some few good specimens of monuments can be seen from railroad—Tertiary, horizontal.

3. Monument. Mesozoic rocks seen standing up at foot of mountains, four miles west.

4. Divide. Tertiary rocks reach over Mesozoics, and lie on granite in hill west of station.

5. Larkspur, Glade, Castle Rock. Fine Tertiary mesa of flat-topped hills.

Colorado Central Railroad.—6. Golden Junction to Golden City. Road runs between two volcanic mesas, (formerly one, now cut in two by Clear Creek).

7. Longmont(?) (Valmont?)—a dike near railroad station. These are the only igneous rocks occurring in the Sedimentaries along the base of Colorado range. (See Hayden's Report, 1873—figures —.)

8. Georgetown. Silver mines and reduction works. Excursion to Gray's Peak easily made in two days—train arrives at noon and leaves at 1 o'clock.)

Denver Pacific Railroad.—9. Hughes. View of Pike's Peak in extreme south; Mt. Evans group, west-south-west; Gray's and Torrey's Peaks, up a valley (Clear Creek), with the volcanic mesas at its mouth, 12 miles west; James and Arapahoe Peaks, west; Long's Peak (double summit) west. Several snowy peaks to northwest, unnamed on maps. (Drainage Map of Colorado, Hayden, 1877, —.)

UTAH.

1. Ogden. View of Wahsatch Mountains to east, a very fine range, as seen in afternoon light, when eastern train arrives; southeast, Archæan, with Weber Canon cut in it, through which the railroad has come out into valley; east, "Fault Canon," faulted Cambrian lying on Archæan, recognized by color; Ogden Canon; northeast, Eden Pass, another fault; north and north-northeast, Paleozoic rocks on Archæan. Lake terraces show all along base of mountains, by gray horizontal line, very distinct.

Utah Central Railroad.—2. Leaving Ogden and rounding long Quaternary slope south of Weber River, a long stretch of Wahsatch range comes into view. From Fault Canon, north; Archæan, at base; Paleozoic, above; between Fault Canon and Centreville station, including Weber Canon, all Archæan. Then begins the great synclinal, as seen from along here. The north end, a little south of east from Centreville (Cambrian to Carboniferous), shows on top of mountains; and the south end, Twin Peaks (Cambrian), and Lone Peak (granite intruded through Archæan), in farthest distance, showing over lower Tertiary hills south of Centreville. The axis of the synclinal (of soft, Mesozoic rocks) being low and hidden. The old lake terrace is *very clearly* seen.

3. Centreville to Salt Lake City. Around west base of hills, formed of Paleozoic rock, dipping south, (part of synclinal), overlaid by unconformable Tertiary rocks.

4. Salt Lake City. Walk north, one hour, to Ensign Peak, (or better, an hour farther northeast, to point whence northeast can be seen also—giving fine view in all directions.) The Wahsatch range fills the east, from north to south. Other mountains are: Northwest, Antelope Island, in lake, Archæan. North-northwest, beyond Antelope Promontory Mountains and Island; west, Lakeside, Stansbury and Cedar Mountains; southwest, Quairrh Mountain; west-southwest, Aquí Mountain; south, Pelican Mountain, (beyond Traverse)—Carboniferous, all running north and south; south, Traverse Mountains, east and west—Trachyte—cut through in middle of River Jordan, coming from Utah Lake, (fresh of course), north to Great Salt Lake. From Ensign Peak can be seen the city; the fertile valley of the Jordan, (fertile from irrigation); the lake; Camp Douglas (U. S. troops) on terrace east of and commanding city; Emigration Canon, through which the Mormons first came to the valley. Salt Lake is better than Colorado Springs for excursions.

Wyoming, Utah and Nevada.

BY MR. ARNOLD HAGUE, ASSISTANT GEOLOGIST ON THE UNITED STATES GEOLOGICAL EXPLORATION OF THE 40TH PARALLEL.

LIST OF GEOLOGICAL FORMATIONS IN THESE TERRITORIES,

In the region of the Union Pacific and Central Pacific Railroads.

GENERAL TABLE.	WYOMING.	UTAH.	NEVADA.
20. QUATERNARY.	20. Quaternary.	20. Up. Quatern'y.	20. Up. Quatern'y.
19 c. PLIOCENE.		20. Lower Quat'y.	"
"	19 c. Niobrara.	19 c. Humboldt.	19 c. Humboldt.
19 b. MIOCENE.			19 b. Truckee.
"	19 b. White River.		
19 a. EOCENE.	19 a. Bridger.		
"	19 a. Green River.	19 a. Green River.	19 a. Green River.
"	19 a. Vermill'n Ck.	19 a. Vermill'n Ck.	
18. CRETACEOUS.	18 d. Laramie.	18 d. Laramie.	No Cretaceous in Nevada.
"	18 c. Fox Hill.	18 c. Fox Hill.	
"	18 b. Colorado.	18 b. Colorado.	
"	18 a. Dakota.	18 a. Dakota.	
17. JURASSIC.	17. Jurassic.	17. Jurassic.	17. Jurassic.
16. TRIASSIC.	16. Red Beds.	16. Red Beds.	16. Star Peak.
"			16. Kolpato.
14. CARBONIFEROUS.		14-15. Perm. Carb.	
"		14 c. Up. Cl. Mres.	14 c. Up. Cl. Mres.
"	14. Coal Measures.	14 b. Weber Quart.	14 b. Weber Quart.
"		14 a. Low. Cl. Mres.	14 a. Low. Cl. Mres.
13. SUB-CARBONIFER'S.		13. Sub-Carbonif's.	13. Sub-Carbonif's.
9-11. DEVONIAN.		9-11. Nevada l. s.	9-11. Nevada l. s.*
"		Ogden Quartzite.	Ogden Quartzite.
5-7. SILURIAN.		5-7. Ute Limestone	5-7. Ute Pog. li'ne.
2-4. CAMBRIAN.		2-4. Cambrian.	2-4. Cambrian.
1. ARCHÆAN.	1 b. Huronian.	1 b. Huronian.	1. Archæan.
	1 a. Laurentian.	1 a. Laurentian.	

* Upper Helderberg to Chemung.

Wyoming.		Ms. Union Pacific Railroad—Continued.	
Ms.	Union Pacific Railroad.		
463 Bushnell, Neb.	19 c. Niobrara, Pliocene.	542 Buford.	1 a. Lauren'n, Archæan.
473 Pine Bluffs, Wy.	"	549 Sherman.*	"
484 Egbert.	"	559 Harney.	"
496 Hillsdale.	"	564 Red Buttes.	17. Jurassic & Triassic.
508 Archer.	"	570 Fort Sanders.	18 a. Dakota, Cretace's.
516 CHEYENNE. ¹	"	573 Laramie City.	"
523 Hazard.	"	581 Howell.	"
531 Otto.	"	589 Wyoming.	18 b. Colorado, Creta's.
536 Granite Canon ²	1 a. Lauren'n, Archæan.	599 Cooper's Lake.	"
		608 Lookout.	"
		616 Miser.	"

1. At Chalk Bluffs, 15 miles southeast from Cheyenne, the Niobrara Pliocene and White River Miocene are both exposed, the latter resting unconformably upon the beds of the Laramie Cretaceous.

2. Both to the north and south of Granite Canon the Paleozoic beds may be seen resting against the Archæan rocks.

3. Sherman, the highest station along the line of the Union Pacific Railroad, lies 8,271 feet above sea-level, and is on the summit of the Colorado Range.

Ms. Union Pacific Railroad—Continued.		Ms. Central Pacific Railroad.
625	Rock Creek.	18 b. Colorado, Cretac's.
640	Como. ⁴	17. Jurassic.
648	Medicine Bow.	18 b. Colorado, Cretac's.
657	Carbon. ⁵	18 d. Laramie, Cretac's.
668	Percy. ⁶	"
682	St. Mary's.	"
690	Walcott's.	18 c. Fox Hill, Creta's.
696	Fort Steele.	"
711	Rawlins. ⁷	14 b. Coal Measures.
724	Separation.	18 d. Laramie, Cretac's.
739	Creston.	"
754	Wash-a-kie.	19 a. Ver'n Ck. Eocene.
764	Red Desert.	"
779	Table Rock.	"
787	Bitter Creek.	"
791	Black Buttes.	18 d. Laramie, Cretac's.
801	Hallville.	"
807	Pt. of Rocks. ⁸	"
818	Salt Wells.	20. Quaternary.
826	Baxter. ⁹	18 d. Laramie, Cretac's.
832	Rock Springs ¹⁰	"
847	Green River. ¹¹	19 a. Green Riv. Eocene.
860	Bryan.	19 a. Bridger, Eocene.
878	Granger.	"
888	Ch'reh Buttes ¹²	"
903	Carter.	"
915	Bridger.	19 a. Ver'n Ck. Eocene.
930	Piedmont.	19 a. Green Riv. Eocene.
939	Aspen.	18 c. Fox Hill, Cretac's.

Nevada.	
Central Pacific Railroad—Continued.	
167	Montello.
183	Toano.
193	Pequop.
195	Otcgo.
205	Independence.
214	Cedar.
220	Wells. ¹⁹
227	Tulasco.
252	Halleck.
257	Peko.
266	Osino. ²⁰
275	Elko. ²¹
287	Moleen. ²²
299	Carlin.
308	Palisade. ²³
326	Be-o-wa-we.
336	Shoshone.
347	Argenta.
360	Battle Mount'n.
379	Stone House.
394	Iron Point.
403	Golconda.
414	Tule.
419	Winnemucca.
430	Rose Creek.
20.	Quaternary.
"	"
"	"
14 a.	Lower Coal Mres.
"	"
20.	Quaternary.
"	"
Basalt.	"
20.	Quaternary.
"	"

Utah.	
Union Pacific Railroad—Continued.	
957	Evanston. ¹³
968	Wahsatch. ¹⁴
977	Castle Rock.
993	Echo.
1009	Weber. ¹⁵
1021	Devil's Gate. ¹⁶
1026	Uinta. ¹⁷
1032	Ogden. ²⁰
19 a.	Ver'n Ck. Eocene.
"	"
"	"
"	"
14 b.	Lower Coal Mres.
1.	Archæan.
20.	Quaternary.
"	"

20.	Quaternary.
"	"
"	"
19 a.	Green Riv. Eocene.
20.	Quaternary.
14 c.	Upper Coal Mres.
20.	Quaternary.
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4. The railroad passes through the axis of an anticlinal fold, exposing an excellent section of Jurassic strata.

5. Carbon offers an excellent opportunity for studying the Cretaceous coals of Wyoming.

6. To the south of Percy station, Elk Mountain, which rises conspicuously above the plain, consists of Archaean crystalline schists, with Paleozoic and Mesozoic strata upon the slopes.

7. Rawling's Peak consists of an Archaean mass, surrounded by Paleozoic and Mesozoic beds. In the coal measures is an interesting body of iron ore.

8. Northeast from Point of Rocks is a remarkable outburst of leucite rocks.

9. There is exposed here an interesting section of Laramie coal rocks.

10. Near Rock Springs the coal formations are well shown.

11. Along the bluffs of Green River are seen the best exposures of the Green River Eocene.

12. On the south of the railroad, between Church Buttes and Carter, may be seen distant but good views of the Uinta Range.

13. About 3 miles north of Evanston are situated the Rocky Mountain and Wyoming coal Company's mines, where there is a good section of the Laramie beds.

14. From Wahsatch to Echo the railroad passes through Echo Canon, where are exposed both the Vermillion Creek and Laramie formations, the former lying unconformably upon the latter.

15. Passing through Weber Canon, from Lost Creek to Weber station, there is exposed a series of beds from the top of the Jurassic, through the Triassic, Upper Coal Measures, Weber Quartzite to the base of the Lower Coal Measures.

16. At the Devil's Gate the Archaean rocks of the Wahsatch Range are characteristically shown.

17. The terraces of Lake Bonneville, which stand over 900 feet above the present level of Salt Lake, may be seen from Uinta station.

18. On the north side of the railroad at Matlin the old lake terraces are distinctly cut in basalt.

Ms.	Central Pacific Railroad—Continued.	Ms.	Utah Central Railroad.	Following the base of Wah- satch Range.
440 Raspberry.	19 c. Humb't, Pliocene.	0 Ogden.	20. Quatern'y.	
448 Mill City. ²⁴	" [side.	16 Kaysville.	"	
459 Humboldt. ²⁵	16. Triassic, on the east	22 Farmington	"	
471 Rye Patch.	"	26 Centreville.	"	
481 Oreana.	19 c. Humb't, Pliocene.	29 Wood's Cross'g.	"	
488 Humbo. Bridge.	20. Quaternary.	37 Salt Lake City.	"	
493 Lovelocks.	"	Utah Southern Railroad.		
502 Granite Point.	" [station.	0 Salt Lake City.	20. Quaternary.	
509 Brown's. ²⁶	Rhyolite just west of the	17 Junction.	"	
521 White Plains.	"	31 Lehi.	"	
528 Mirage.	19 b. Truckee, Miocene.	48 Provo.	"	
535 Hot Springs. ²⁷	Basalt on the east side.	66 Payson.	"	
546 Desert.	Basalt on the west side.	75 Terminus.	"	
555 Wadsworth. ²⁸	20. Quaternary.	Eureka and Palisade Railroad.		
569 Clark's.	Trachyte.	0 Palisade.	20. Quaternary.	
581 Vista.	20. Quaternary.	12 Evans.	"	
589 Reno.	"	28 Box Springs.	"	
600 Verdi.	"	37 Mineral.	"	
616 Boca.	"	50 Alpha.	"	
624 Truckee, Cal.	"	63 Summit.	"	
Utah Northern Railroad.		78 Diamond.	"	
0 Ogden.	20. Quaternary.	90 Eureka.	"	
14 Willard.	"	Virginia and Truckee Railroad.		
22 Brigham.	"	0 Reno.	20. Quaternary.	
32 Honeyville.	"	11 Steamboat.	"	
43 Hampton's.	"	21 Franktown.	"	
53 Mendon.	"	30 Carson.	"	
60 Logan.	19 c. Humbo't Pliocene.	39 Eureka.	"	
80 Franklin.	"	51 Virginia. ²⁹	Propylite.	
		Carson City.	20. Quaternary.	

19. From Wells there is a fine view of the East Humboldt Range. Mount Bonpiand attains an elevation of 11,321 feet above sea-level.

20. Just east of Osino the railroad passes through Osino Canon, exposing a good section in the Weber Quartzite.

21. In the neighborhood of Elko may be seen the Green River Eocene, Humboldt Pliocene, characteristic outbursts of rhyolite and the "Chicken Soup" hot springs.

22. In Moleen Canon the Carboniferous formations are well shown.

23. Palsade Canon cuts through rhyolites; there are also exposed andesites and trachytes.

24. Mill City is the most convenient place to leave the railroad in order to study the characteristic Triassic formations of the West Humboldt Range.

25. From Humboldt there is a fine view of the West Humboldt Range. In the neighborhood are some interesting outbursts of basalt and a deposit of sulphur.

26. In the Montezuma Range, west of Brown's station, the volcanic rocks are well shown. It is an interesting place to study rhyolites and basalts.

27. The Hot Springs, a short distance east of the station, reach the surface near the base of basaltic hills.

28. The Truckee Canon, just east of Wadsworth, offers remarkable outbursts of a great variety of volcanic rocks. There may be seen here basalts, rhyolites, trachytes, andesites and propylites.

29. Propylite is the characteristic volcanic rock, which carries the Comstock Lode. A. H.

30. The last rail completing the Pacific railroads, from Omaha to San Francisco, was laid May 10th, 1869.

See notes on page 165.

* By Dr. J. G. Cooper, late Assistant State Geologist.

1. Volcanic and glacial, with 1. Archaean (granite) and metamorphosed rocks of uncertain age. Metalliferous but not rich. Mt. Stanford, northward, is 9,500 feet high.
2. Glacial, and detrital above 16. Triassic and 17. Jurassic sandstones, containing most of the gold mined on the western slopes.
3. Detrital above 1. Archaean (granite). Surface mining.
4. The mountains to the east produce lime, marble, copper ore and some lignite (19 c. Pliocene).
5. Mt. Diablo, 3,876 feet high, is in full view and easily ascended from near the coal mines.
6. Follows the 20. Quaternary (alluvial) nearly after passing through Alameda Canon 10 miles, traversing 19. Tertiary, 19 c. Pliocene and 19 b. Miocene, then lignitic, with little coal.
7. The islands visible are all like S. F. in geological structure.
8. Redwood Peak, 1,635 feet high, is the highest in the range opposite S. F. Mission Peak, 34 miles southeast, is 2,566 feet high.
9. Mountains on the east side rise to 4,443 feet and on the west side to 3,780 feet in height.
10. The "High Sierra," 14,000 to 15,000 feet, can be seen on clear days. The mountains eastward have the same general character as on the line from Boca to Sacramento, with the addition of some 18. Cretaceous unlites near base.

Southern Pacific Railroad.			California Pacific Railroad—Continued.			
Ms.	Tulare Division.		Ms.	Napa Branch.		
146 Goshen.	} 11	20. Quaternary.	31 Napa Jun'n	} 15	20. Quaternary.	
157 Tulare.		"	39 Napa.		"	
167 Tipton.		"	45 Oak Knoll.		"	
179 Alila.		"	52 Oakville.		"	
187 Delano.		"	58 St. Helena.		"	
199 Posa.		"	66 Calistoga.		"	
207 Lerdo.		"	Main Line.			
220 Sumner.		"	31 Napa Junct'n. ¹⁶	} 18	20. Quaternary.	
242 Caliente.		"	39 Bridgeport. ¹⁷		"	
Oregon Division Central Pacific Railroad.			44 Fairfield.		"	
0 Sacramento.	} 12	20. Quaternary.	55 Elmira.		"	
8 Arcade.		"	59 Batavia.		"	
15 Antelope.		"	63 Dixon.	"		
18 Junction.		{ 19. Tertiary, Pliocene,	71 Davis.	"		
29 Lincoln.		{ with workable lign'e.	84 Sacram'to.	"		
33 Ewing's.		20. Quaternary.	Marysville Branch.			
40 Wheatland.		"	0 San Francisco.	(As before.)		
46 Reed's.		"	71 Davis.	20. Quaternary.		
50 Yuba.		"	81 Woodland.	"		
52 Marysville.		"	85 Curtis.	"		
70 Gridley.		"	90 Knight's Land ¹ .	"		
83 Nelson.		"	Stockton & Visalia and Stockton & Copperopolis Railroads. ¹⁹			
90 Durham.	} 13	"	0 Stockton.	} 20.	Quaternary.	
96 Chico.		"	6 Charleston.		"	
105 Anita.		"	11 Holden.		"	
110 Soto.		"	15 Peter's.		"	
122 Sesma.		"	15 Peter's.	} 20.	Quaternary.	
123 Tehama.		"	22 Waverly.		"	
135 Red Bluff.		"	30 Milton.		"	
170 Redding. ¹⁸		"	Volcanic.	15 Peter's.	} 20.	Quaternary.
Alameda Branch.			20 Farmington.	"		
San Francisco.	} 18 c. Lign. & Metamorphic Cretaceous.		28 Clyde.	"		
Oakland Wharf.		20. Quaternary.	34 Oakdale.	"		
Oakland.		"	Southern Pacific Railroad of California.			
Alameda Stat'n.		"	0 San Francisco.	} 18 c. Lign. & Metam. Cretaceous.		
Fruit Vale.	{ 20. Quatern'y and 19 c. Tertiary Plioc.	6 San Miguel.	"			
Fernside.	"					
California Pacific Railroad.						
0 San Francisco.	} 18 c. Lign. & Metam. Cretaceous.					
25 Vallejo. ¹⁴		20. Quaternary & 18. Cretaceous.				
31 Napa Junction.		"				

11. The mountains westward are like those from Pleasanton to Niles, with more 19. Tertiary, 19 b. Miocene and 18. Cretaceous. Also 20. Quaternary, volcanic and granite in places. The only coal now worked is north of Mt. Diablo and south of Livermore. The granite, of the coast ranges at least, is eruptive, and belongs rather to the Quaternary than the Archæan.

12. The mountains eastward resemble those farther to the south, but with more 18. Cretaceous, some 13. Sub Carboniferous near the middle, and a vast 20. Quaternary volcanic field northward.

13. Mt. Shasta, 14,400 feet high, is in view.

14. The fossil forest is on this route.

15. The hills on both sides are metamorphic (18. Cretaceous?), with volcanic outbursts increasing toward the northeast, and with quicksilver deposits.

16. St. Helena Mountain is 4,343 feet high.

17. Tunnel through 18. Cretaceous and 19. Tertiary hills.

18. The coast range westward, 5,000 to 8,000 feet high, is little explored, but resembles that south of San Francisco Bay, with much more volcanic, and towards the north auriferous, but only granitic or metamorphic rocks, containing the gold quartz, underlie the cretaceous, as far as now known.

19. The most northern group of "Big Trees" is approached by this route.

20. Passing into 19. Tertiary, 19 c. Pliocene and 1. Archæan (granite) below it.

Southern Pacific Railroad of California— Ms. <i>Continued.</i>		Southern Pacific Railroad of California. Ms. Los Angeles Division— <i>Continued.</i>	
12 Baden. ²¹	20. Quaternary.	0 Los Angeles.	20. Quaternary.
17 Millbrae. ²²	"	5 Florence.	"
21 San Mateo.	"	10 Compton.	"
25 Belmont.	"	15 Cerritos.	"
28 Redwood City. ²³	"	20 Wilmington. ²⁴	"
33 Menlo Park.	"		
38 Mountain View. ²⁴	"	0 Los Angel's	20. Quaternary.
44 Lawrence's.	"	9 San Gabriel	"
50 San Jose.	"	13 Monte.	"
63 Coyote.	"	29 Spadra.	"
73 Tennant. ²⁵	"	42 Cucamon's.	"
80 Gilroy. ²⁶	"	57 Colton.	"
83 Carnadero.	"	61 Mound City	"
86 Sargent's.	"	72 El Casco.	"
96 Vega. ²⁷	"	80 San Geronia. ²⁴	"
99 Pajaro.	"	93 Jacinto.	"
110 Castroville. ²⁸	"	101 Whitewater.	"
118 Salinas.	"	104 Seven Palms.	"
128 Chualar.	"	130 Indian Wells.	"
134 Gonzales.	"		
143 Soledad.	"		
Los Angeles Division.		San Francisco & Northern Pacific R. R.	
80 Gilroy. ²⁹	20. Quaternary.	0 San Francisco.	{ 18 c. Lign. & Metam. Cretaceous.
94 Hollister.	"	34 Donahue.	20. Quaternary, Volcanic.
100 Tres Pinos. ³⁰	"	42 Petaluma.	"
0 Los Angeles. ³¹	20. Quaternary.	49 Page's.	"
22 San Fernando.	"	57 Santa Rosa.	"
0 Los Angeles.	20. Quaternary.	61 Fulton.	"
6 Florence.	"	70 Grant's.	"
13 Downey.	"	82 Geyserville.	"
17 Norwalk.	"	90 Cloverdale.	"
23 Costa.	"		
27 Anaheim.	"		

21. A ridge of marine 19 c. Pliocene Tertiary, full of shells, &c., lies west of the road for five miles.

22. Metamorphic Cretaceous hills west of road, and granite (1. Archæan?) below.

23. 19 b. Miocene (Tertiary) hills come near on the west.

24. 18. Metamorphic Cretaceous hills on the west, mostly capped by 19 c. Miocene Tertiary (marine.)

25. The celebrated New Almaden Quicksilver Mines are not far west.

26. Some Lignitic (19 a. Eocene and later) exists to the west, but has not yet been found workable.

27. Passes through the 18. Cretaceous hills, flanked by 19. Tertiary (19 a. Miocene and 19 b. Pliocene) on the west. Some lignite in it.

28. The hills to the southwest are metamorphic and granitic, with 19. Tertiary on their flanks as before.

29. Much 19. Tertiary on the slopes of hills around, with very fine marine fossils (19 b. Miocene and 19 c. Pliocene).

30. The New Idria Quicksilver Mine lies to the southeast in the highest part of this range of mountains, near 5,000 feet elevation.

31. The hills northward are metamorphic (18. Cretaceous?), with a great 19. Tertiary (19 b. Miocene and 19 c. Pliocene) basin between them and the range north of San Fernando. To the east more metamorphic and granitic, with auriferous quartz, copper, &c. The 19. Tertiary contains much petroleum.

32. A metamorphic (18. Cretaceous) hill north of this harbor. The islands visible are similar, with some 20. Quaternary sandstone and Paleozoic rocks.

33. About half way the metamorphic and granitic hills approach the road. Much 19 b. Miocene Tertiary, with poor lignite, caps these on the west.

34. Metamorphic auriferous rocks (secondary) overlying granite, chiefly on the west side. San Bernardino Mountain is 11,600 feet high.

35. The foothills are full of Tertiary fossils (Miocene and Pliocene). The metamorphic and volcanic mountains contain valuable quicksilver mines.

36. Some indications of quicksilver in the hills. Chromic iron and pyrolusite are also found in large quantities.

37. Mt. Tamalpais, 2,604 feet high, may be ascended here. Gives a magnificent view of the country near San Francisco Bay.

Ms.	Northern Pacific Coast Railroad.	Ms.	Northern Pacific Coast R. R.—Cont. ss
0	San Francisco. { 18 c. Lign. & Metam. Cretaceous.	17	Junction. { 18 c. Lign. & Metam. Cretaceous.
11	San Quentin. ^{ss} { " "	19	Parker's. { " "
15	San Rafael. ^{ss} { " "	25	Nicasio. { " "
17	Junction. { " "	31	Taylorville. { " "
		35	Garcia. { " "
0	San Francisco. { 18 c. Lign. & Metam. Cretaceous.	424	Millerton. { " "
6	Saucelito. { " "	473	Marshall's. { 19 b. Tertiary, Miocene.
10	Lyford's. { " "	55	Tomales. { " "
15	Tamalpais. { " "		
17	Junction. { " "		

38. The only groves of the celebrated "Redwood" tree, accessible by railroad, are on this route and northward. J. G. C.

Washington Territory.¹

Ms.	Northern Pacific Railroad.	Portland to Canyon City—River and Stage Line—Lewiston River and Railroad. (Among the finest scenery of the continent.)
0	Kalama. Basalt hills. ^{ss}	Portland. { On the left Basalt Mts., on the right Alluvial.
5	Carroll's. " "	Vancouver. { Alluvial and Post Pliocene gravels.
8	Monticello. " "	Sandy. { " "
11	Cowlitz. " "	
28	Olequa. " "	
37	Winlock. " "	
48	Newaukum. 19. Tertiary hills.	
60	Skookum C'k. 19. Cretace's, with coal.	
66	Tenino. { Mound Prairie, a strange grouping of natural mounds.	Cascades. { Basalt Mts. overlying fossil leaf-beds and petrified wood—whole trees, stumps & roots in place.
96	Lake View. { 19 c. Pliocene deposits, overlaid with glacial drift.	Up. Cascades. { Conglomerate, &c.
105	New Tacoma. { 19 c. Pliocene deposits, overlaid with glacial drift.	Rock Creek. { Abundance of silicified oak in Tertiary con- glomerates.
	Down Puget Sound. " "	Collin's. { Buried forests.
	Seattle. 18. Cretaceous coal.	Hood River. { Sight of Mt. Hood and Mt. Adams.
		Dalles City. { Pliocene sandstone, with fossil leaves and Post Pliocene fossil beds.
		Hence to Lewiston by Railroad or River. To Canyon City by Stage.
		The Dalles { Through wonderful beds of mammalian fossils of 19 b. Miocene age, cor- responding with the "Mauvaises Terres," or bad lands of Ne- braska and Dakota.
		to {
		Canyon City. {

1. Furnished by Prof. Condon, the State Geologist of Oregon.

2. *Basalt* is an igneous rock occurring in the volcanic and trap series. The 18. Cretaceous era, and still more the 19. Tertiary and 20. Quaternary, were remarkable for the extent of the eruptions over the western part of this continent in Oregon, Washington, &c. Basalt being an intrusive rock is not here distinguished by any number denoting its age, as that can only be known by the formation on which it rests, or that resting upon it, if there be any.

Oregon.*

Oregon and California Railroad. (Up the Willamette Valley.			Ms.	Oregon and California R. R.—Cont.	
0	Portland.	{ Hills on west. Basalt alluvial gravel plain east. 19 b. Miocene fossils in the river bed. Basalt hills.	81	Albany.	{ The above rock seen across the river.
7	Milwaukee.		87	Tangent.	{ An extended bed of an ancient inland sea, named by Prof. Condon "The Willamette Sound," with abundance of 20. Ter. fossils.
11	Clackamas.		98	Halsey.	
16	Oregon City.	{ Bed of river and hills on both sides columnar basalt. A transverse dike of trap, with amygdaloid. Hills of basalt. The bed of the river and the now widening valley of 20. Post Pliocene contain abundant fossil remains of bos, latifrons, elephas, mastodon and horse.	106	Harrisburg.	{ The hills again with abundant 19 b. Miocene fossils. Volcanic tufas and porphyries.
20	Rock Island.		110	Junction.	
25	Canby.	{ The streams here to right and left expose this 20. Post Pliocene mud. The river bed is 20. Post Pliocene. The hills are rich with 19 b. Miocene marine fossils. A ridge of dark colored 19. Tertiary crosses the line of travel here—rich in fossils.	124	Eugene.	{ Carbonaceous shale, with coal 18. Cretaceous. Metamorphic.
29	Aurora.		135	Creswell.	
33	Hubbard.		145	Latham.	{
40	Gervais.		148	Divide.	
53	Salem.		156	Comstock.	{
61	Turner.		161	Rice Hill.	
67	Marion.		181	Oakland.	{
72	Jefferson.		200	Roseburg.	
(Exposure a mile above the town on the Santiana River.)			Oregon Central Railroad.		
		{ Hills of basalt, overlying 19 b. Miocene. Basalt.	0	Portland.	{
			6	Summit.	
		{ To Forest Grove over the bed of the 20. Post Miocene inland sea, connected with the main one of Willamette Valley, through the Tualatin and Chehallem Valley. Hills of fossil rock right and left, 19 b. Miocene.	9	Ross Landing	{
			11	Beaverton.	
			16	Readsville.	
			24	Hillsboro.	
			29	Cornelius.	
				Forest Grove.	
		{ Hills of fossil rock right and left, 19 b. Miocene.	32	Gaston.	{
			48	St. Joseph's.	

* Furnished for this work by Prof. Thomas Condon, of the Oregon State University, Eugene City, Oregon, the State Geologist.

Delaware and the Eastern Shore of Maryland.

Delaware Railroad.		Ms. Maryland and Delaware Railroad.	
(Operated by the Philadelphia, Wilmington and Baltimore Railroad.)			
0 Wilmington.	{ 18. Cretaceous? 17. Jurassic.	0 Clayton. 18. Cretaceous.	
6 New Castle.	18. Cretaceous.	5 Kenton. "	
16 Kirkwood.	19 a. Eocene?	14 Marydell. "	
21 Mt. Pleasant.	"	20 Goldsboro. "	
25 Middletown.	"	24 Greensboro. "	
29 Townsend.	19 b. Miocene.	32 Hillsboro. "	
37 Clayton.	18. Cretaceous.	44 Easton. "	
Queen Anne's and Kent Railroad.			
37 Clayton.	18. Cretaceous.	0 Townsend. 19 b. Miocene.	
39 Smyrna.	20. Post Pliocene.	10 Massey's Junct. "	
37 Clayton.	18. Cretaceous.	14 Millington. "	
48 Dover.	19 b. Miocene.	26 Tilghman's. "	
51 Wyoming.	"	36 Centreville. "	
56 Canterbury.	"	Kent County Railroad.	
58 Felton.	"	Wilmington. (As before.)	
64 Harrington.	"	0 Clayton. 18. Cretaceous	
68 Farmington.	"	10 Massey's Junct. "	
76 Bridgeville.	"	20 Kennedyville. "	
84 Seaford.	20. Post Pliocene.	31 Chestertown. "	
90 Laurel.	"	36 Parsons. "	
97 Delmar.	"	Dorchester and Delaware Railroad.	
Eastern Shore Railroad.			
0 Delmar, Del.	19 b. Miocene Tertiary.	0 Seaford. 20. Post Pliocene.	
6 Salisbury, Md.	20. Post Pliocene.	10 Federalsburg. "	
10 Eden.	"	14 Williamsburg. "	
19 Princess Anne.	"	20 East Newmarket "	
24 Westover.	"	33 Cambridge. "	
28 Kingston.	"	Wicomico and Pocomoke Railroad.	
32 Marion.	"	0 Salisbury. 20. Post Pliocene.	
38 Crisfield.	"	10 Pittsville. "	
Junction, Breakwater, Franklin and Worcester Railroad.			
Wilmington.		19 St. Martin's. "	
0 Harrington.	19 b. Miocene Tertiary.	23 Berlin. "	
9 Milford.	"	29 Newark. "	
12 Lincoln.	"	37 Snow Hill. "	
17 Ellendale.	"	Wilmington and Western Railroad.	
25 Georgetown.	"	0 Wilmington. { 18. Cretaceous.	
25 Georgetown.	19 b. Miocene Tertiary.		{ 17. Jurassic.
31 Harbeson.	20. Post Pliocene.	12 Ashland. 2-8. Silurian.	
33 Cool Spring.	"	17 Southwood. "	
36 Nassau.	"	20 Landenberg. "	
40 Lewes.	" (Modern.)	Wilmington and Northern Railroad.	
25 Georgetown.	(As before.)	0 Reading, Pa. (See Pennsylvania.)	
41 Frankford.	20. Post Pliocene.	39 Coatesville. "	
54 Berlin.	"	57 Chadd's Ford. 1. Azoic.	
68 Snow Hill.	"	61 Smith's Bridge. "	
77 Stockton.	"	63 Centre. "	
81 Franklin.	" (Modern.)	65 Dupont. "	
		66 Greenville. "	
		68 Lancaster Road. "	
		72 Wilmington. { 18. Cretaceous.	
			{ 17. Jurassic.

* By Prof. P. R. Uhler, of the Peabody Institute, Baltimore.

Maryland and District of Columbia.*

Philadelphia, Wilmington and Baltimore Railroad.		Baltimore and Ohio Railroad. Washington Branch.	
Ms.		Ms.	
0 Philadelphia. (See Pennsylvania.)		0 Baltimore. ⁷	17. Jurassic.
28 Wilmington. 18. Cret. & 17. Jurassic.		0 Camden Sta'n	
30 Delaware Junc.	"	9 Relay House. ⁹	1 a. Lauren'n, Granite.
32 Newport.	"	19 Annapolis Jun.	17. Jurassic.
34 Stanton.	"	22 Laurel.	"
40 Newark.	"	28 Beltsville.	"
46 Elkton.	"	34 Alexandria Jun.	"
52 Northeast. ¹	"	34 Bladensburg.	"
55 Charlestown.	"	40 Washington. ⁹	" 1. a. Lauren.
61 Perryville.	" & Archæan.	Alexandria Branch.	
(Susquehanna River.)		0 Baltimore.	(As before.)
62 Havre-de-Grace. 18. Cret. & 17. Jurassic.		34 Alexandria Jun.	17. Jurassic.
67 Aberdeen.	"	40 Banning's.	"
74 Bush River. ³	"	42 Uniontown.	"
77 Edgewood.	"	46 Shepherd.	Cretaceous & Jurassic.
79 Magnolia.	"	Annapolis and Elk Ridge Railroad.	
89 Stemmer's Run.	"	0 Annapolis Junc.	19. Cret. & 17. Jurass.
94 Bay View.	"	3 Patuxent.	"
98 Baltimore.	"	6 Odenton.	20. Recent 17. Jurassic.
Philadelphia and Baltimore Central R. R.		9 Gambrill's.	"
0 Philadelphia. (See Pennsylvania.)		10 Millersville.	Cretaceous.
36 Kennett.	"	12 Waterbury.	"
52 Oxford.	"	14 Crownsville.	"
60 Rising Sun.	1 a. Lauren'n, Serpentine.	16 Iglehart.	"
67 Rowlandville.	"	18 Camp Parole.	"
71 Port Deposit. ³	" Granite.	21 Annapolis. ¹	{ " & 1 a. Lauren'n ? Eocene in vicinity.
75 Perryville.	"	Northern Central Railroad.	
112 Baltimore. ⁷		0 Baltimore.	{ 17. Jurassic and 1 a. Laurentian.
Baltimore and Potomac Railroad.		2 Mount Vernon.	"
0 Baltimore. ⁷	17. Jurassic & 1 a. Laur.	7 Green Springs	{ 2-4. Siluro-Cambri'n,
19 Odenton. ⁹	" and recent.	7 Junction. ⁴	Serpentine.
21 Patuxent.	"	12 Timonium.	"
26 Bowie.	"	15 Cockeysville.	{ " large quar- ries of white marble.
34 Wilson's.	" 18. Cret. near.	20 Sparks'.	2-4. Siluro-Cambrian.
41 Navy Yard. ⁹	"	23 Monkton.	{ 1 a. Laurentian, Mica Schists.
43 Washing'n, D. C.	"	29 Parkton.	{ 1 a. Lauren'n, Granite and Serpentine.
Pope's Creek Branch.		35 Freeland's.	1 a. Laurentian.
0 Baltimore. ⁷	17. Jurassic	42 Glenrock.	"
26 Bowie.	17. Jurassic	47 Hanover Ju., Pa.	2-4. Siluro-Cambrian.
40 Marlboro.	19 a. Miocet.	57 York, Pa.	"
46 Linden.	"	(Continued in Pennsylvania.)	
55 Beantown.	"		
65 La Plata.	"		
69 Cox.	"		
75 Pope's Creek.	"		

* By Prof. P. R. Uhler, of the Peabody Institute, Baltimore, except B. & O. R. R. west.

1. Kaolin occurs near Annapolis, near Northeast, and near the Metropolitan Railroad in Montgomery county.

2. Harford county, a few miles northwest of the Philadelphia, Wilmington & Baltimore Railroad, yields a fine green serpentine in vast blocks, equal to verd-antique in splendor and polish, besides the common building sort. In the Jurassic beds on the same railroad, also on the Washington branch of the Baltimore and Ohio Railroad, vast beds of nodular carbonates of iron occur, rich in metal.

3. The Woodstock, Ellicott's City and Port Deposit granites are superior of their kind.

4. Bare Hills mineral region. It has chrome and copper ores, asbestos, serpentine and magnesian rocks.

Ms. Western Maryland Railroad. 5		Ms. Baltimore & Ohio Railroad—Continued.	
0 Baltimore. ⁷	{ 17. Jurassic and 1 a. Laurentian.	62 Frederick.	1 b. Huron'n limestone.
3 Fulton Station.		69 Point of Rocks.	16. Triassic. Pot. marb.
5 Oakland.	"	0 Washington. ⁹	17. Upp. Jur.? & Azoic.
6 Arlington.	"	7 Silver Spring.	"
9 Howardsville.	"	11 Knowles'.	"
10 Pikesville.	" Serpentine.	16 Rockville.	1 b. Huronian.
11 Greenwood.	"	22 Gaithersburg.	" Serpentine.
14 Owing's Mills.	"	27 Germantown. ¹	"
19 Reisterstown.	" Granite.	29 Boyd's.	" Talc. schists.
22 Finksburg.	" Copper.	33 Barnesville.	"
31 Tannery.	"	36 Dickerson's.	16. Triassic?
34 Westminster.	" Marble.	43 Pt. of Rocks. ¹⁰	" Potomac Marble.
41 New Windsor.	" Var'gd Marble.		
45 Union Bridge.	"	69 Point of Rocks.	16. Triassic. Pot. Marb.
48 Middleburg.	"	75 Berlin.	1 b. Huronian.
49 Frederick.	16. Triassic.	79 Weverton.	"
51 Rocky Ridge.	" Trap.	80 Sandy Hook.	"
61 Emmitsburg.	16. Triassic.	81 Harper's Fry ¹¹	"
59 Mechanicstown.	2 b. Potsdam, (Marble.)	87 Duffield's, Va.	3 a. to 4 c. Sil.-Cam. l. s.
69 Blue Ridge.	"	92 Kearneysville.	"
71 Waynesboro.	"	95 Vancievesville.	"
77 Smithsburg.	4 a. Trenton limestone.	100 Martinsburg.	"
86 Hagerstown.	"	107 Nor. Mount'n. ¹²	5-12. Silu. & Devonian.
93 Williamsport.	4 c. Hudson River.	117 Sleepy Creek.	"
106 Martinsburg.	3 a. & 4 c. Cal. & Huds.	122 Hancock. ¹³	10. Ham. & 7. L. Held'g.
Baltimore and Ohio Railroad. 6		128 Sir John's Run.	8-12. Devonian.
0 Baltimore. ⁷	17. Upp. Jur.? & Azoic.	138 Orleans Road.	"
15 Ellicott City. ⁸	1 a. Laur'n, Gran. quar.	153 Paw Paw.	"
20 Elysville. ⁸	"	163 Green Spring.	7. L. Held. & 8. Oris.
25 Woodstock. ⁸	"	170 Patterson's Ck.	10. Hamilton.
27 Marriottsville.	" Gran. & Steat. qu.		8. Oriskany.
32 Sykesville.	"	178 Cumberland, Md.	7. Lower Heldb'g to 13 a. Vespertine.
43 Mount Airy.	1 b. Huronian.		
50 Monrovia.	" Slate quarries.		
58 Frederick Junc.	" Triassic near.		

5. The Western Maryland Railroad has copper mines, chrome, serpentine, talc, steatite, asbestos, carbonate of iron, and most beautiful marbles of every color, from black, dark red, salmon, &c., to pure white—even statuary marble—besides the breccias of every degree of size in their component pebbles or pieces, both round and angular. P. R. U.

6. By Prof. William M. Fontaine, of Morgantown, West Virginia.

7. Baltimore is situated near the junction of the Azoic metamorphic rocks, with a series of clays and sands, underlying the cretaceous beds. The age of these clays has not been fixed. Some consider them to be Lower Cretaceous, others Upper Jurassic. They are probably Upper Jurassic, and not far distant in age from the Fredericksburg sandstones of Virginia. The surface clays in South Baltimore are probably of Post Pliocene age.

8. The rocks of the eastern portion of the Azoic area in Maryland, as in Virginia, are granites, gneisses and hornblende rocks, probably of Laurentian age. This belt extends to near Parr's Ridge, where it is succeeded by Argillites, with some metamorphic limestone, probably of Huronian age. This latter belt extends to some one and a half miles west of Harper's Ferry, where it is succeeded by the Primordial and overlying strata.

9. The Azoic area passes some distance to the west of the railroad from Baltimore to Washington, consequently this road runs entirely in formations similar to those found at Baltimore. Washington has a geological position similar to that of Baltimore, but here the subjacent rocks are plainly similar in age to the Fredericksburg sandstones, and are probably Upper Jurassic.

10. On the west side of the Monocacy River a belt of Triassic rocks occurs, extending to near the east base of the Catoclin Range. Along the west margin of this belt occurs the remarkable limestone breccia called the Potomac Marble. This is well exposed near Point of Rocks. This Triassic belt is flanked immediately on the northeast and east by a belt of rather impure slaty limestone, belonging to the Azoic area.

11. The gorge at Harper's Ferry is cut through metamorphic rocks, of probably Huronian age. One and a half miles west of the station, a fault brings down the Potsdam and Calcareous rocks against the Azoic. From this point, 83 miles, to near North Mountain, 107 miles, a wide belt of Lower Silurian limestone occurs, with occasional bands of slate, embracing the rocks from the 8 a. Calcareous to and including the 4 c. Hudson River. These have never been separated in this region. The limestone predominates by far, and will be spoken of as the 2-4. Siluro-Cambrian.

Cumberland and Pennsylvania Railroad.		Cumberland and Pennsylvania Railroad—	
		Ms.	Continued.
0 Cumberland,	10. Hamilton.	13 Morantown.	14 c. Upper Coal Mrs.
	8. Oriskany.	17 Frostburg.	" "
	7. Lower Helderb'g.	20 Borden Shaft.	" "
to	5 b. Clinton.	22 Ocean Mines.	" "
	5 a. Medina.	25 Jackson.	" "
	5 a. Oneida.	29 Barton.	" "
2 Will's Gap.	4 c. Hudson River.	34 Piedmont, W. V.	" "
4 C. & P. Junct'n	4 c. up to 14 b. Low. Coal Measures.		
7 Patterson's.			
8 Barrelville.			
10 Mount Savage.			

12. On the west side of this limestone belt, a great fault brings down in North Mountain, the various Silurian and Devonian formations from the 5 a. Medina to the 13 a. Vespertine or No. X, which are to be seen in North Mountain and its immediate vicinity.

13. From North Mountain to Cumberland a wide belt of highly disturbed strata occurs. Owing to the close compression of the folds in which the strata are thrown, many of the formations contained in this belt are always to be seen at any given locality, and hence when any formation is given for a station it must not be inferred that this alone occurs there.

In this belt the following formations are to be found: The 5 a. Oneida, 5 b. Clinton, 7. Lower Helderberg, 8. Oriskany, 10. Hamilton, 11 a. Portage, 11 b. Chemung, 12. Catskill, and 13 a. Vespertine. These have never been clearly separated from each other. The hard sandstones, such as the 5 a. Oneida and 8. Oriskany, usually form the crests of the ridges, and the softer strata, more commonly the Hamilton, compose the valleys and foot hills.

W. M. F.

West Virginia.

For the List of Formations see that of Virginia, page 179.

Baltimore and Ohio Railroad.		Baltimore & Ohio Railroad—Continued.	
Ms.	From Cumberland, West. ¹	Ms.	
178 Cumberland. ²	{ 13 a. Vesper'ne s.s. & 11 b. Chemung.	206 Piedmont. ⁵	14 b. Low. Barren Mrs. and Low. Coal Mrs.
186 Brady's Mill. ³		208 Bloomington.	13 b. Umbral red s.s.
	7. Lower Helder. s.s.	214 Frankville.	14 a. Conglomer. in 1700 feet
	8. Oriskany.	220 Swanton.	" "
201 Keyser. ⁴	10. Hamilton.	223 Altamont.	" "
	11 a. Portage.		

1. Compiled from information furnished by Professors J. J. Stevenson and Wm. M. Fontaine.

2. In the gorge where Will's Creek cuts through Dan's Mountain there is a fine exposure of the Lower 13 a. Poccono or Vespertine grey sandstone, resting on the brown sandstone of the Upper 11 b. Chemung, in lofty cliffs.

3. The 7. Lower Helderberg limestone is here exposed, and on the Virginia side of the Ohio River a great mass of limestone and shales is seen, the latter being probably composed of the Waterlime beds and the Onondaga marls. Somewhat further east the conglomerate is seen in the top of the mountain, with an underlying coal bed.

4. Here the railroad enters the East Front Ridge of the Allegheny, in which the Oriskany sandstone shows a high bluff, and where there are extensive exposures of the 10. Hamilton, 11 a. Portage and other Devonian groups.

5. Here the conglomerate is near the water level. The hills are composed of the Lower Coals and the Lower Barren Measures. A small remnant of the Pittsburgh seam is found high up in the hills on the west side of the river, and is worked. From Piedmont, which is 919 feet above tide, the railroad ascends, by a grade 17 miles long, to the height of 2,620 feet, at Altamont. From Cumberland to Piedmont great quantities of very large, rounded stones occur, having much the appearance of glacial drift, and often rising to the height of 80 feet on the hill sides.

Ms. Baltimore & Ohio Railroad—Continued.		Ms. Baltimore & Ohio Railroad—Continued.	
226 Deer Park. ⁶	14 a. Cong. On a broad	347 Ellenboro. ¹³	14 b. Low. Bar. Series.
232 Oakland.	“ flat topped	352 Cornwallis.	“
242 Cranberry.	“ mountain.	355 Cairo. ¹³	“
	{ 13 b. Umbral,	362 Petroleum. ¹³	“
253 Rowlesburg.	{ 13 a. Vespertine and	364 L. F. Junct'n ¹³	14 b. L. Prod. Coal Ser.
	{ 11 b. Chemung.	369 Walker's.	14 b. Low. Barr. Series.
260 Tunnelton.	{ 14 b. L. Coal Mrs. &	374 Kanawha. ¹³	“
(Preston Cl. Basin.)	{ 14 a. Conglomerate.	377 Davisville.	14 c. Upp. Bar. Series?
267 Newburg. ⁷	{ 14 c. Pittsburg Coal,	384 Parkersburg.	“ ?
	{ 14 b. Lower Barren.		
274 Thornton.	14 b. L. Coal & L. Barr.	280 Grafton.	14 b. Low. Barr. Series.
280 Grafton.	14 b. Lo. Barren Series.	294 Texas.	14 b. L. Prod. Coal Ser.
284 Webster's.	“	297 Benton's Ferry ¹⁴	“
287 Simpson's.	14 b. & c. Lower Barr.	302 Fairmont.	14 c. Up. Pro. Coal Ser.
290 Flemington. ⁸	& Upp. Prod. C. Series.	304 Barrackville.	14 c. Upp. Prod. C. and
297 Bridgeport.	“		Upper Barren Series.
302 Clarksburg. ⁹	“	312 Farmington.	14 c. Upper Barr. Ser.
306 Wilsonburg. ¹⁰	“	319 Mannington.	“
316 Salem.	14 c. Upper Barren Ser.	330 Barton.	“
	14 c. Upp. Barr. & Upp.	337 Littleton. ¹⁵	“
321 Long Run. ¹¹	Productive Coal Series.	344 Bellton.	“
326 Smithton.	“	351 Cameron.	“
328 West Union.	“	362 Roseby's Rock.	“
332 Central.	14 c. Upp. Bar. Series.	375 Benwood. ¹⁶	14 c. Up. Pro. C. Series.
342 Pennsboro.	“	379 Wheeling.	“

6. West of Altamont the railroad continues on a broad, undulating plateau, the Savage and Allegheny Mountains of Pennsylvania having here coalesced into one. This remarkable flat mountain top, from 2,400 to 2,600 feet in height above tide, has always attracted much attention from the comparative softness of the outlines of the topography, giving a park-like character to its topography.

7. Here the Lower Coals and Lower Barren Measures are shown, with a small remnant of the Pittsburg bed in the tops of the hills, it being the seam worked there.

8. At this station is the eastern outcrop of the Pittsburg coal bed, west from the anticlinal of Laurel Hill, (Chestnut Ridge of Pennsylvania.) From this locality the coal and the railroad level constantly approach, until at Wolf's Summit, a little west from Wilsonburg, the coal is under the track.

9. The Pittsburg seam is extensively worked here.

10. Just before reaching Wolf's Summit, the Pittsburg coal bed is at the railroad level, and is worked near the track at the Summit. The Redstone coal bed is seen two inches thick in the Summit cut. Between the Summit and the Brandy Gap Tunnel the Waynesburg coal bed is seen, and is worked just south from the railroad, the opening being visible from the track. At the west end of the tunnel the Washington coal bed is exposed above the track. This is in the Upper Barren Measures.

11. Here the track comes down to the Waynesburg bed, which is rudely mined here and at several localities between this and West Union station.

12. About one-fifth of a mile east of this station, a fault crosses the railroad, which brings up the Lower Barren Series against the Upper Barren Series. Thence, from Ellenboro to within a short distance of Petroleum station, the rocks are nearly horizontal, and the Upper Freeport coal bed is exposed in several of the cuts. But, near Petroleum, there is a most remarkable upheaval, which has brought up the lower coals, the strata suddenly rising within a few yards to an angle of 80 degrees. Just west of Laurel Fork Junction the rocks dip down again, the conditions being here on the west side similar to those at Petroleum on the east. After passing the first cut west from the station, the dip is suddenly reduced from 50 degrees to nearly horizontal. This forms the so-called "Oil Break," as all the productive oil wells are found along the line of this belt. This belt is about one and a half miles wide, running in a direction a little east of north and gradually flattening out towards each extremity, and forms one of the most remarkable geological features in this State. This curious disturbance is well worth a visit. Near it, a few miles off by a branch road from Cairo, is the vertical chasm, 4 feet wide, which was filled with the mineral Grahamite, now worked out.

13. There is a fault here, forming the western boundary of the disturbed region, as that at Ellenboro is the eastern. The distance between the two faults at Ellenboro and Kanawha is 37 miles. From Ellenboro to the east side of the "Oil Break" is 15 miles, the belt being two miles wide, and from the west side of the break to Kanawha is 10 miles, so that the upheaval at the "Oil Break" is between the two faults. The geology from this point to Parkersburg has not been determined, as the vertical extent of this fault has not been ascertained.

14. Between Grafton and Benton's Ferry the railroad passes through the arch of Laurel Hill. At the Valley Falls, above Nuzum's Mills, the conglomerate is exposed alongside of the track, and in the bed of the river. The lower coals are well shown for some distance below Nuzum's Mills.

15. The road at these stations crosses some of the highest strata to be found in the Appalachian coal field.

16. Between Benwood and Wheeling the openings in the Pittsburg coal bed are numerous, and the Sewickley and Redstone coal beds are exposed in the bluffs at many places.

Virginia and West Virginia.²³

BY PROF. WILLIAM B. ROGERS.

List of the Geological Formations Found in Virginia and West Virginia.

	GENERAL GROUPS.	SUB-DIVISIONS IN VIRGINIA AND WEST VIRGINIA.	Numbers marking the Paleozoic Formations of Penn. and Va., as used in the Annual Reports of W. B. and H. D. Rogers.	Names adopted by H. D. and W. B. R. for the Paleozoic Formations of Pennsylvania and Virginia and used in H. D. Rogers' Final Report of the Geology of Pennsylvania.
Cenozoic.	QUATERNARY.	20. Quaternary.		
	TERTIARY.	19 c. Pliocene. 19 b. Miocene. 19 a. Eocene.		
	UPPER AND LOWER MESOZOIC.	(18 & 17.) Jurasso-Cretac's. ¹ Upper Secondary s. s. (17, 16.) Jurasso-Triassic. ² Mid. Secondary Sandstones and Coal Measures.		
Paleozoic.	UPPER CARBONIFEROUS.	14 c. Upper Barren Group. 14 c. Upper Coal Group. 14 b. Lower Barren Group. 14 b. Lower Coal Group. 14 a. Great Conglomerate and Conglo. Coal Group.	XVI. XV. XIV. XIII. XII.	Seral. Seral. Seral. Seral. Seral.
	MID. CARBONIFEROUS. (UPPER SUB-CARB.)	13 b. Greenbriar Shales. 13 b. Greenbriar Limestone. (Carb. Limestone.)	XI. XI.	Umbral Shales. Umbral Limesto.
	LOWER CARBONIFEROUS. (LOWER SUB-CARB.)	13 a. Montgomery Grits and Coal Measures. (Tuedian ?)	X.	Vespertine Sandstone and Coal.
	DEVONIAN.	Names of N. Y. Survey chiefly: 12. Catskill. 11 b. Chemung. 11 a. Portage. 10 c. Genesee. 10 b. Hamilton. 10 a. Marcellus.	IX. VIII. VIII. VIII. VIII. VIII.	Ponent. Vergent. Vergent. Cadent. Cadent. Cadent.
	SILURIAN.	8. Oriskany. 7. Lower Helderberg. 6. Salina. 5 c. Niagara. 5 b. Clinton. 5 a. Medina.	VII. VI. V. V. V. IV.	Meridian. Pre-Meridian. Scalent. Scalent. Surgent. Levant.
	SILURO-CAMBRIAN ³ OR UPPER CAMBRIAN.	4 c. Hudson River. 4 b. Utica. 4 a. Trenton.	III. III. III.	Matinal. Matinal. Matinal.
	MIDDLE ⁴ AND LOWER CAMBRIAN.	3 c. Chazy. 3 b. Levis. 3 a. Calciferous. 2 b. Potsdam Group. ⁵	II. II. II. I.	Auroral. ⁴ Auroral. Auroral. Primal. ⁵
	ARCHÆAN.	Archæan. A, B, C, D. ⁶		

Virginia.			Ms. Chesapeake and Ohio Railroad.
Baltimore and Ohio Railroad.			
Ms.	Harper's Ferry and Valley Branch.		
0	Harper's Ferry.	Altered Cambrian (b) or Archæan B, followed west by Cambrian, 2 b., 3 a.	0 Richmond. { W. outcrop of Tert'y and Upper Mesozoic, all resting on Arch. C.
1	Shenandoah	Cambrian, 3 a., b.	9 Atlee's. 19. Tertiary.
6	Halltown.	" 3 b., c.	18 Hanover C. H. "
10	Charleston.	" "	28 Hanover Junct. { Upper Mesozoic, Jurasso-Cretaceous.
14	Cameron.	Siluro-Cam., 4 a. & 4 b.	33 Noel's. 1. Archæan, C.
23	Wadesville.	{ Siluro-Cam. & Camb. 4 a. and 3 c.	40 Beaver Dam. { Gneiss & Mica Slates, with veins of Granite.
27	Stephenson's.	{ The road runs close to boundary of Cambrian 3 c., and Sil.	45 Bumpass. 1. Archæan, A.
32	Winchester.	{ Cambrian, 4 a., of the belt lying east, composed largely of 4 c.	50 Frederick's Hall "
36	Kernstown.	{ Siluro-Cambrian, 4 a. and 4 b., on switch track.	56 Tolersville. ¹⁰ { Mic. Hornb. & Hydro. Mic. Slates, with Aurif. quartz. The gold belt.
39	Newtown.	Cambrian, 3 b., c.	62 Louisa. 1. Archæan, C.
42	Vauchuse. ⁷	" "	76 Gordonsville. " B.
44	Middletown.	" "	81 Lindsay's. { Argil. Mic. & Hydro. Mic. Slates, with patches of Slaty Limest. and Steatite Epidotic.
46	Cedar Creek.	" "	88 Cobham. { Chlor. and Sil. Grits and Slates of S.W.Mt. followed west by Gneissoid Sandstone.
50	Capon Road.	" "	90 Keswick. 1. Archæan, D.
51	Strasburg Junc.	" "	97 Charlottesville. Horn. & Chl. Gnei. Syen.
55	Tom's Brook.	{ Camb. & Siluro-Cam. 3 c. and 4 a.	104 Ivy. { 1. Arch., B. Bl. Ridge
57	Mauertown.	" "	107 Mechum's River. { Epid. Chlor. Argil. Slates, &c., flanked W. by Camb. I, 2 b. Pots.
61	Woodstock.	" "	115 Greenwood. { Cambrian, 3 a., ad-joining slates of 2 b.
66	Edinburg.	" "	124 Waynesboro. { Sil-Camb., 4 a. & 4 b.
74	Mount Jackson	" "	129 Fishersville. { Edge of slate belt.
81	New Market.	Cambrian, 3 b., c.	136 Staunton. { Camb. & Sil.-Camb., 3 c. and 4 a.
88	Broadway	" "	144 Swoope's. "
94	Linville.	" "	
100	Harrisonburg. ⁸	" "	
105	Pleasant Valley.	" "	
117	Fort Defiance. ⁹	" "	
126	Staunton.	" "	

1. The term Jurasso-Cretaceous is chosen to designate the Upper Secondary sandstones of the Virginia reports and the associated sands and clays which in their prolongation, northeast through Maryland, Delaware and New Jersey, are found to underlie the Cretaceous green-sand formation of those States, because the fossils found in the vicinity of Fredericksburg, &c., in Virginia, as well as near Baltimore, suggest the upper stage of the Jurassic period; while it is stated that the sands and clays of this belt in New Jersey are referable to the base of the Cretaceous. The whole group would seem in the main to be one of transition, and it is probably best comparable to the European Wealden.

2. The name Jurasso-Triassic is preferred for the Mid-Secondary rocks of the Virginia reports, as it is thought to correspond best with the fossil indications thus far furnished by the several belts included in it. Of these, the most western area is in part continuous with the so-called Triassic belt of Maryland and Pennsylvania, and in part with the coal bearing rocks of Dan River, North Carolina. The middle belt is in the line of prolongation of the Deep River coal rocks of North Carolina; and the eastern belt, including the Grits and Coal Measures of Chesterfield, Henrico, &c., is topographically without a counterpart. The middle and eastern belts in Virginia, and the western tract in North Carolina, show a close agreement in their fossil flora, which in many particulars has a decidedly Jurassic character, and all three belts are connected by certain species of *Estheria*, *Candona*, &c., held in common. Collectively these beds represent most probably a group of deposits ranging through Upper Triassic and Lower Jurassic time, and are in large measure of a transitional character.

3. In grouping the Lower Paleozoic formations, Sedgewick's classification is used, including as *Cambrian* and *Siluro-Cambrian*, all the formations from the base of the Paleozoic to the top of the Trenton period (4 c.), and as *Silurian* the succeeding formations to the top of the Oriskany (3.); these corresponding in limits to the Lower and Upper Silurian periods of the table.

4. The Middle Cambrian, or Auroral group, occupying much of the surface of the great valley west of the Blue Ridge, and exposed in numerous anticlinals and faults in the mountain belt farther west, is marked by a great preponderance of magnesian limestones in the lower two-thirds of its mass, passing below in many cases into Arenaceous and Argillaceous limestones, and followed above by oolitic and by cherty and sandy beds, these latter giving place still higher to the

Ms. Chesapeake & Ohio R. R.—Continued.		Ms. Chesapeake & Ohio R. R.—Continued.	
150	North Mountain	195	Jackson's River ¹³
159	Craigsville.	205	Covington. ¹⁴
168	Goshen. ¹¹	221	Alleghany.
175	Millboro. ¹²		
Devonian, 10 a., adjoining Silurian of the Gap, 5 a., 5 b. to 8., inverted.		Devonian, 10 a., west side of Rich Patch Anticlinal Silurian, 5 a. to 8.	
Silurian 7., Encrinal Marble. 8. Oriskany.		Devonian, 10 a. & 10 b., between southwest end of Warm Spring Anticlinal, & northeast end of Peter's Mountain.	
Devonian, 10 a. & 10 b., between ridges of Silurian, 5 a. to 8.		Devonian, 10. to 12., enclosing, near tunnel, belt of Sub-Car. 13 a. Vespertine.	
Devonian, 10 a., near 8. of Sideling Hill.			

more purely Calcareous and Argillo-Calcareous strata appertaining to the base of the Siluro-Cambrian, Trenton or Matinal group. The frequent faults, inversions and repetitions of the beds in the great valley, and the rarity of fossils in the Auroral rocks, have interfered with a precise demarcation of formations; but there can be little doubt, from fossil and other evidence, that they cover the period of the formations 3 a., 3 b., 3 c., assigned to them in the Table. Hence, and as indicating the formations *near* as well as *at* the localities, the designation 3 a. b. will be used for these rocks up to the top of the magnesian, without distinguishing between Calcareous and Quebec (or Levis), and 3 b. c., for the remaining strata up to the well defined base of the Siluro-Cambrian, Trenton or Matinal group, 4 a. b. and c.

5. The Potsdam, or Primal group, includes in Virginia, where complete, besides the Potsdam proper, the ferriferous shales next above, and the slates, shaly grits and conglomerates, below this formation. It is exposed in varying mass and completeness on the western slope and in the west flanking hills of the Blue Ridge throughout much of its length, often, by inversion, dipping to the southeast, in seeming conformity beneath the older rocks of the Blue Ridge, but often, also resting unconformably upon or against them. These older rocks, comprising masses referable probably to Huronian and Laurentian age, include also a group of highly altered beds, corresponding apparently to the copper-bearing or Keweenaw series of northern Michigan, and perhaps to the lately described Dimetian rocks of Wales.

6. The letters A, B, C, D mark four rather distinct groups of Archæan rocks found in Virginia, of which the first three may probably be referred to the Laurentian, Huronian and Montalban periods respectively, and the fourth to an intermediate stage—the Norian or Upper Laurentian.

7. This belt of Siluro-Cambrian slates extends continuously from the Potomac River to a point about ten miles south of Staunton, a distance of 140 miles, beyond which it becomes narrow and discontinuous. In the tract corresponding to the interval, from Strasburg to Harrisonburg, it encloses the complex synclinal of the Massanutten Mountains, consisting of massive ranges of Silurian rocks 5 a., 5 b., with some bands of 7 and a few tracts of Devonian 10 a., all resting in the wide undulated trough of the slates. From Strasburg southwest, the railroad keeps generally a distance of from one half to one mile west of the edge of the slates, but sometimes impinges upon it, affording ready access to fossiliferous beds of 4 a., b. and c.

8. About 13 miles west-by-north from this are the Rawley Springs, and a few miles farther the remarkable fissured rocks known as Moravian Town, both in Point 12. West-by-south, about 20 miles, are the Dora coal mines, in Vespertine 13 a., of Narrowback Mountain—anthracite, faulted and crushed. The irregular fault which, with many interruptions, extends from near the Potomac River along the northwest edge of the Great Valley in the line of the Little North Mountain for about 120 miles, is seen near these localities to bring the Siluro-Cambrian 4. of the valley into juxtaposition with the Devonian 10. to 12.

9. About eight miles east of this are Weyer's and Madison's caves, situated in a ridge of steep dipping limestone, 3 a. b., near the South River.

10. In this part of the gold belt are situated the old workings known as Tindler's, Boxley's, Baker's, Triple Fork and Walton's Mines.

11. This is a good point of departure for examining the rock structure of Panther Gap, 5 a. b., mostly inverted, and the wild passage of the North River through the same formations at Strecker's Gap, "The Goshen Pass." About 10 miles southwest are the Rockbridge Alum Springs, in 10 a. b.

12. About three miles north of this, on the Cow Pasture River, is the Blowing Cave of Bath County. In an anticlinal of 8. Oriskany; and twelve miles farther north-by-west, near the same river, is the noted intermittent stream called the Ebbing Spring, in a ridge of 7 and 8, on east side of Fowler Hill, east of Warm Spring Axis. 12 miles southwest to Bath Alum Springs, in 10 a., and thence 5 miles to Warm Springs, 3 c.-4 a.

13. Where traversed by the Jackson's River, this anticlinal shows itself as a great arch built up of the successive concentric beds of 5 a. b. c., and flanked by 7. and 8., followed by 10 a., and having a span, as measured by the highest sandstone bed, of about 3,300 feet. The main arch, 5 a. Levant, or Medina, white sandstone, is regular and unbroken, but the outer concentric belts, made up of the hard members of 5 b. c., are distorted and in part inverted on the west side of the axis, where by a slight fault the beds of 7. pass suddenly from a nearly vertical to a horizontal position. Towards the southwest, this axis opens, to form the Rich Patch Valley, bringing to view the Siluro-Cambrian 4 a. b. c., and still farther southwest becomes the closed anticlinal known as the Pott's Creek Mountain. Heavy beds of iron ore (Hematite) have been opened on both sides of this axis, as at Roaring Run, Callie's, Low Moor, and Kayser's near Clifton Forge, associated with formation 8. Oriskany. The fossil ore of 5 b. is also mined at several points.

Washington City, Virginia, Midland & Great Southern Railroad—Continued.

121 North Garden.	From one and a half miles west of Charlottesville to near Lynchburg the prevailing rocks are Syenite, Granite, Protogine, Mic. & Chlor. Gneiss. Near base of S.W. Mt. are belts of Gneissoid sand and steaschist. Mic. & Hor. Sl. & Trap.	
127 Coveseville.		
131 Fabus.		
133 Rockfish.		
137 Elmington.		
140 Lovington.		
145 Arrington.		
149 Tye River.		
152 New Glasgow.		
157 Amherst.		
163 McIvor's.		
166 Burford's.		
171 Lynchburg. ^{1a}		
177 Lucado.		
182 Lawyer's Road		
188 Evington.		
192 Otter River.		
195 Lynch's.		
199 Staunton River.		
205 Sycamore.		
209 Ward's Springs.		
215 Whittles.		
220 Chatham.	{ Mesozoic, 17-16, Jurasso-Triassic, W.mar.	
226 Dry Fork.		
230 Fall Creek,		
236 Danville.		
237 Dundee.	I. Archæan, C.	

Manassas Division of W. C., Va., Mid. and Great Southern Railroad.

0 Alexandria.	(As before.)	
27 Manassas Junc.	Mes., 17-16. Juras-Tria.	
36 Gainesville.	"	
38 Haymarket.	"	
40 Thoroughfare.	{ 1. Archæan, B, Slaty Quartzite, Epid. Chlo. Argil. & Mic. Slates of Bull Run and Pond Mountains.	
44 Broad Run.		
49 Plains.	I. Archæan, C.	
54 Salem.	"	
60 Rectortown.	" B.	
63 Delaplane.	"	
67 Markham.	"	
72 Linden.	"	
76 Happy Creek.	"	
79 Front Royal.	Cambrian, 3 a. Calcifer.	
81 River.	Sil-Camb. 4 a. & b. Tr. & Ut. 4 c. Hudson Riv.	
85 Buckton.	{ Fort Mt. Synclinal, (5 a. & b.) ends near.	
86 Water Lick.	" 4. a. & b. Tr. & Ut.	
90 Strasburg.	"	
91 Strasburg Junc.	"	

Richmond, Fredericksburg and Potomac Railroad.

Washington. (Steamboat.)		
0 Quantico.	{ Upper Mesozoic, 17-18. Jurasso-Creta.	
5 Richland.	"	
12 Brooke's.	{ " Patches of 19. Tertiary on denuded surface.	
14 Potomac Run.	"	
21 Fredericksburg.	{ " Resting on gneiss at Falls.	
33 Guinea's.	19. Tertiary.	
42 Milford.	"	
47 Penola.	"	
53 Ruth Glen.	Jurasso-Creta's, 17-18.	
58 Junction.	"	
60 Taylorsville.	"	
65 Ashland.	{ 20. Quaternary gneiss coming to surface, Archæan, C.	
82 Richmond.	(Same as before.)	
84 Manchester Crossing.	{ 20. Quaternary, on decomposing Gneiss, Archæan, C.	
87 Temple's.	"	
90 Drewry's Bluff.	"	
93 Halfway.	"	
95 Chester.	{ W. limit of Upp. Mesozoic and 19. Tertiary.	
98 Port Walthall J.	"	
105 Petersburg.	E. outc. of Gne. Arch C	
115 Reams.	"	
127 Stony Creek.	Gneiss higher up, on crk { Gneiss short distance W. Tertiary ditto E.	
135 Jarratt's.	19. Terti. short dist. E.	
147 Bellfield.	"	
154 Greensville Jun.	"	
164 Pleasant Hill.	"	
168 Weldon.	E. outc. of Gn. in Riv., C	

Piedmont Air Line Railroad.

0 Richmond.	(Same as before.)	
2 R. F. & P. Junc.	"	
22 Powhatan.	W. edge of Mes. cl. field	
36 Amelia C. H.	1. Archæan, A.	
58 Burkeville.	"	
73 Keysville.	"	
90 Roanoke.	"	
101 Scottsburg.	"	
109 Boston. ¹⁷	1. Archæan, C.	
127 Barksdale.	"	
135 Ringgold.	"	
141 Danville.	"	
156 Ruffin, N. C.	"	

deposit exists in that region at the depth of 558 feet below the surface, overlaid by Miocene and Pliocene beds, and resting upon an Eocene deposit identical with that which underlies it at Richmond. We are thus assured of the great extension seaward of this deposit, and have the means of estimating the thickness of the Tertiary formations as far east as the mouth of the James River.

Richmond, York River and Chesapeake Railroad.		Atlantic, Mississippi and Ohio Railroad—	
Ms.		Ms.	Continued.
0 Richmond. ¹⁸	(Same as before.)	191 Concord.	1. Archæan, B.
7 Fair Oaks.	{ At Richmond tunnel cuts Tert'y Infusorial bed, 19 b. Miocene.	204 Lynchburg.	1. Archæan, A.
13 Dispatch.	{ In this interval both Lower and Upper 19. Tertiary are accessible above tide level.	215 Forrest.	"
15 Summit.	{ Eocene and Miocene.	229 Liberty.	"
20 Tunstall's.	{ In this interval, only Upper 19. Tertiary is accessible above tide level.	241 Buford's.	2-4. Cambrian, 3 a. Cal.
24 White House.		246 Blue Ridge.	" 3 a. b.
26 Fish Hand.		251 Ronsack's.	" "
31 Sweet Hall.		254 Gish's.	" "
38 West Point.		252 Big Lick.	{ " & Sil-Cambrian.
		264 Salem. ¹⁹	{ " 3 c & 4 a Ch. & Tr.
		277 Big Spring.	" "
		281 Alleghany.	" 3 b. c.
		285 Big Tunnel.	" "
		290 Christiansburg. ²⁰	" "
		301 Central.	" "
		302 New River.	" "
		309 Dublin.	" "
		316 Martin's.	{ Fault of Draper's Mt. Silurian & Devonian against Sub-Carbonif.
		329 Max Meadows.	2-4. Cambrian, 3 b. c.
		337 Wytheville. ²¹	" "
		350 Rural Retreat.	" & Sil-Cam. 3 c, 4 a.
		364 Marion.	" "
		380 Glade Spring. ²²	" "
		393 Abingdon.	" "
		408 Bristol.	" "
		Continued as East Tennessee, Virginia & Georgia Railroad.	
		Seaboard and Roanoke Railroad.	
		0 Portsmouth.	{ 20. Quat. on 19. Ter. and 19 c. Pliocene.
		17 Suffolk.	20. Quat. on 19 b. Mioc.
		31 Carrsville.	"
		37 Franklin.	"
		42 Nottoway.	"
		50 Newson's.	"
		55 Boykin's.	"
		63 Margarettsville.	"
		68 Seaboard.	"
		78 Gary's.	"
		80 Weldon.	Outcrop of Gneiss.

19. From this point, for many miles towards the southwest, the railroad runs near to and almost parallel with the broken synclinal, (about 25 miles long), of which the lofty Catawba and Fort Lewis Mountains are the principal parts. The former, composed of southeast dipping 4 a. b., &c., forms the farther or northwest rim of the synclinal, and bending abruptly around at its northeast end, becomes the Tinker Mountain, which closes the basin in that direction. A shorter and gentler bend at the southwest end, terminates in a fault. The corresponding rocks of the southeast, or near side of the synclinal, are only partially preserved in a narrow inverted ridge at either end, the remainder of this rim of the synclinal having been engulfed in the prolonged fault, which, for many miles along the margin of the basin, has brought the Siluro-Cambrian rocks (4 a. c.) of the valley to abut against, and over-ride the Devonian 10. to 12. and the Vespertine 13 a., of which the Fort Lewis Mountain, the central mass of the synclinal, is mainly composed.

20. A few miles west-by-north of this is an area of Vespertine rocks 13 a., including one or more workable beds of coal, mined on Stroubler Run and elsewhere. This area, once probably continuous with the Vespertine of Fort Lewis Mountain, is almost encompassed by faults. Farther to the northwest, and separated from the above by a belt of Cambrian and Siluro-Cambrian rocks 3 c., 4 a., &c., the Vespertine beds of the southeast slope of the Brushy Mountain, contain a similar coal, mined on Tom's Creek, &c., all these seams being more or less affected by the neighboring faults. The dislocation which, southeast of Brushy Mountain, brings Vespertine and Umbral in apposition with Siluro-Cambrian Matinal, is part of the great fault which, with some changes of direction and character, extends along the northwest edge of the great valley, from near the James River to the end of the Brushy Mountain, northeast of Abingdon, a distance of about 125 miles.

Ms. Washington and Ohio Railroad.		Ms. Washington & Ohio Railroad—Cont.	
0 Alexandria.	(Same as before.)	27 Guilford.	{ Mesozoic, 17-16. Jur- asso-Triassic.
7 Carlin's.	"	31 Farmwell.	"
11 Fall's Church.	1. Archæan, C.	38 Leesburg.	" W. mar. Cong.
15 Vienna.	1. Archæan, A.	42 Clark's Gap.	1. Archæan, B.
18 Hunter's.	"	45 Hamilton.	"
21 Thornton.	1. Archæan, B.	49 Purcellville.	"
23 Herndon.	{ Mesozoic, 17-16. Jur- asso-Triassic.	52 Round Hill.	"

At a distance of 23 miles, in a northwest direction, is the sheet of water called "Mountain Lake," situated near the top of Salt Pond Mountain, at a height of 4,000 feet above tide. Here the Potts and Johns Creek Mountains and the other ridges of 5 a. b. coalesce at their southwest termination, into a lofty rugged table-land, overlooking the New River, and commanding wide views.

21. A few miles south, the Lick Mountain range divides the valley for some miles into two, and in the southern of these belts, on the New River, below the mouth of Cripple Creek, are the Austenville lead mines, in 3 b., near the Primal 2 b. of Poplar Camp Mountain, and about 15 miles distant from Wytheville.

22. From this point a short branch railroad leads north into the valley of the north fork of the Holston River, between Walker's Mountain, 5 a., &c., and Poor Valley ridge, Vespertine 13 c., &c., which flanks the Clinch Mountain on the southeast side. Here, near Saltville, are the remarkable salt wells, which penetrate into a thick mass of rock-salt; and in the same vicinity, and at various points higher up the valley, for a distance of 20 miles, beds of gypsum have been opened and extensively wrought. These deposits are found near and in a line of fault, along which the Siluro-Cambrian 3 c. 4 a., of the southeast side of the valley, has been made to abut against and sometimes over-ride the Umbral 13 b., which, with the Vespertine 13 a. of the Poor Valley Mountain, form a belt on the northwest side of the valley. Both deposits are most probably referable to the Subcarboniferous period. The fault here spoken of extends, with some local changes of character and direction, in a west-by-southwest course, from a point in Giles county to the Tennessee line, a distance of 125 miles, and is prolonged many miles into Tennessee. WILLIAM B. ROGERS.

23. So few details have been published on the geology of Virginia, that no chapter in this volume will be more welcome to geologists than this, which has been wholly and very carefully prepared by Professor William B. Rogers, late State Geologist of Virginia. J. M.

High Rice the surface is deep
to a depth of 100 ft. a
brownish red soil
hard rock - some very soft
thin layers of limestone

North Carolina.¹

Wilmington and Weldon R. R.—162 miles; N. and S. This road runs throughout its whole length from Wilmington to Weldon on the (20) Quaternary formation, with occasional small exposures of the Tertiary (19 a.) Eocene and (19 b.) Miocene and of the (18) Cretaceous in the banks of the streams.

Atlantic and North Carolina R. R.—95 miles; E. and W. From Morehead to Goldsboro, 95 miles; also on (20) Quaternary, with (19) Tertiary and (18) Cretaceous in the banks of the streams.

Piedmont Air Line.		Carolina Central R. R. 229 ms.	
Ms.		Ms.	
00	Richmond, Va.	0	WILMINGTON.
141	Danville, Va.	117	Rockingham.
156	Ruffin.	123	Pedee River. ⁴
165	Reidsville.	128	Lilesville.
183	"	135	Wadesboro.
189	Greensboro.	147	"
N. C. Div. East. Greensboro to Goldsboro.		163	Monroe.
00	Greensboro.	172	"
21	Comp'y's shops	187	CHARLOTTE.
30	"	199	Catawba River
32	Mebanesville.	229	Shelby.
41	Hillsboro. ²		
55	Durham.	Western North Carolina R. R. W. 114 miles.	
69	Morrisville. ³	00	Salisbury.
72	"	102	Marion. ⁵
73	Cary.	106	"
78	"	114	Blue Ridge.
81	RALEIGH.		
96	Clayton.	Western R. R. of North Carolina. S. E. 45 m.	
106	(Neuse River.)	0	Egypt.
109	Selma.	9	Jonesboro.
118	Princeton.	13	Little River.
130	Goldsboro.	45	Fayetteville.
N. W. Nor. Car. R. R. Greensboro to Salem, W. 29 ms. This road runs wholly on Laurentian.			
189	GREENSBORO.	Raleigh and Augusta Air Line R. R.	
204	High Point.	0	Raleigh.
211	Thomasville.	3	"
222	Lexington.	13	"
238	SALISBURY.	14	Apex.
261	Concord.	26	Merry Oaks.
282	CHARLOTTE.	33	Lockville.
302	"	44	Sanford.
312	S. C. State Line	57	Cameron.
Raleigh and Gaston R. R. 97 miles. All on Upper (1 a.) Laurentian.		Wilmington, Columbia and Augusta. 64 miles, W. in N. C.	
Tarboro Branch R. R. 14 miles, E. All on the (20) Quaternary.		00	Wilmington.
		64	Fair Bluff.
			Line of So. Car.

1. Revised and the notes added by W. C. Kerr, State Geologist of N. C.
2. At Hillsboro depot a good exposure of typical N. Carolina Huronian slate, hydromicaceous.
3. At Morrisville depot a dike of dolerite visible. 1½ miles east of station beds of very coarse incompact conglomerate, the bottom beds of the Triassic, and probably glacial.
4. On both sides of the Pedee River are high dikes of dolerite for more than a mile, and 2 miles east a very coarse porphyritic granite, as well as between Lilesville and Wadesboro.
5. From Statesville west in the numerous deep cuts are seen fine examples of the *proet* drift, characteristic of sub-glacial regions. Also from Hickory to Morgantown many sections of the purple paragonite schists, which are peculiar to this region.

South Carolina.*

Ms. Savannah and Charleston Railroad.		Wilmington, Columbia and Augusta Railroad.	
0 Charleston. ¹	20. Post Plioc. (Phosph.)	0 Wilming'n, N. C.	20. Post Pliocene, 102 m
16 Rantowles.	"	45 Whiteville.	"
29 Jacksonboro.	"	64 Fair Bluff.	"
43 Whitehall.	"	87 Marion, S. C.	"
53 Yemassee.	"	94 Pee Dee.	"
70 Grahamville.	"	108 Florence.	19 c. Pliocene, 20 ms.
104 Savannah.	"	120 Timmons ville.	"
Port Royal Railroad.		129 Lynchburg.	20. Post Pliocene.
0 Port Royal.	20. Post Pliocene, 80 m.	138 Marysville.	"
4 Beaufort.	"	147 Sumter.	"
18 Sheldon.	"	166 Acton.	"
25 Yemassee.	"	175 Grovewood.	"
50 Bronson's.	"	197 Columbia.	Granite, 3 miles.
59 Allendale.	"	Cheraw and Darlington Railroad.	
90 Ellenton.	19 a. Eocene, (buhrstone)	0 Florence.	19 c. Pliocene, 20 miles.
112 Augusta.	" 32 ms.	Darlington.	"
South Carolina Railroad.		Cheraw.	20. Pt. Pli. & Hur. 2 m.
0 Columbia.	1. Granite, 3 miles.	Charlotte, Columbia and Augusta Railroad.	
6 Hampton's.	20. Post Pliocene, 22 m.	0 Charlotte.	1 a. Laurentian, 37 ms.
20 Gadsden.	"	45 Chester.	Trap, 15 miles.
25 Kingsville.	"	57 Blackstock's.	1. Gneiss, Laurentian.
31 Fort Motte.	19 a. Eocene, 12 miles.	64 White Oak.	"
38 Lewisville.	"	72 Winnsboro.	"
51 Orangeburg.	20. Post Pliocene.	84 Ridgeway.	{ 1. Gneiss, 2 miles, and Slate, Huron., 18 ms.
68 Branchville.	"	107 Columbia.	Granite, 3 miles.
82 George's.	" Phosphate.	124 Lexington.	19 a. Eocene.
108 Summerville. ²	"	141 Leesville.	"
130 Charleston.	"	169 Pine House.	"
68 Branchville.	20. Post Pliocene, 33 m	184 Graniteville.	Granite, 4 miles.
96 Blackville.	"	186 Augusta.	19 a. Eocene.
105 Williston.	19 a. Eocene, 44 miles.	Chester and Lenoir Railroad.	
113 Windsor.	"	0 Chester.	Trap, 1 mile.
126 Aiken.	"	Yorkville.	1. Gneiss, Laurentian.
145 Augusta.	"	Atlanta & Charl.	Air L. "
North-Eastern Railroad.		Gastonia.	"
0 Florence.	19. Pliocene, 10 miles.	50 Dallas, N. C.	"
9 Effingham.	20. Post Pliocene, 92 m		
20 Scranton.	"		
23 Graham's.	"		
38 Kingstree.	"		
57 St. Stephen's.	"		
83 Mount Holly. ³	" Phosphate.		
102 Charleston.	"		

* Prepared by Professor W. C. Kerr, of Raleigh, State Geologist of North Carolina.

1. This road lies along and on the lower margin of the phosphate bed, from Charleston to the Ashepoo, except about 5 miles on either side of the Edisto River, and crosses it again for 5 miles just east of the Combahee. The bed extends continuously from a point a few miles south of the crossing of Coosawhatchie, in a direction a little north of east to a point some thirty miles north of Charleston. The bed is widest in the neighborhood of Charleston. These points were obtained from a map by Professor F. S. Holmes, of Charleston.

2. The last 20 miles of this road lies on the phosphate beds.

3. The last 30 miles of this road is on the phosphate beds.

Ms. Greenville and Columbia Railroad.		Ms. Greenville & Columbia R.R.—Cont.	
0 Columbia.	1. Gran. 5 m., Hur. 20 m	118 Belton.	1 a. Gneiss, Laurentian.
25 Alston.	1 a. Gneiss, Laurentian.	127 Anderson.	"
32 Pomaria.	"	Pendleton.	"
47 Newberry.	"	Perryville.	"
48 Helena.	"	Walhalla.	"
75 Ninety-Six.	"	Spartanburg and Union Railroad.	
85 Greenwood.	"	25 Alston.	1 a. Gneiss, Laurentian.
94 Hodges or Cok'y	"	Unionville.	"
103 Donald's.	"	Spartanburg.	"
109 Honey Path.	"	Atlanta and Charlotte Air Line Railroad.*	
118 Belton.	"	312 N. C. State Line.	1 a. Huron. Slates, 8 m
125 Williamston.	"	337 Gaffney's, S. C.	1 a. Gneiss, Laurentian.
135 Golden Grove.	"	357 Spartanburg.	"
144 Greenville.	"	387 Greenville.	"
94 Cokesbury.	1 a. Gneiss, Laurentian.	427 Seneca City.	"
106 Abbeville.	"	454 Toccoa City, Ga.	"

* Prof. F. H. Bradley considers this as all Lower Silurian (mostly Quebec group) metamorphic.

Georgia.¹

Ms. Atlantic and Gulf Railroad.		Ms. Brunswick and Albany Railroad.	
0 Savannah.	19 c. Tertiary.	0 Brunswick.	19 c. Tertiary.
24 Fleming.	"	13 Hazlehurst.	"
39 Walthourville.	"	24 Waynesville.	"
53 Doctortown.	"	60 Waycross.	"
57 Jesup.	"	67 Waresboro.	"
86 Blackshear.	"	78 Millwood.	"
122 Homersville.	"	93 Kirkland.	"
130 Dupont.	"	101 Willicoochee.	"
139 Stockton.	"	151 Isabella.	19 a. Tertiary.
157 Valdosta.	"	171 Albany. ²	"
174 Quitman.	19 a. Tertiary.	Macon and Brunswick Railroad.	
188 Boston.	"	0 Brunswick.	19 c. Tertiary.
200 Thomasville.	"	40 Jesup.	"
214 Cairo.	"	70 Baxley.	"
226 Climax.	"	93 Lumber City.	19 a. Tertiary.
236 Bainbridge.	"	100 Town's.	"
200 Thomasville.	19 a. Tertiary.	140 Dubois.	"
232 Camilla.	"	148 Cochran.	"
258 Albany. ²	"	161 Buzzard Roost.	"
130 Dupont.	19 c. Tertiary.	171 Bullard's.	"
151 Statensville.	"	186 Macon.	Metamorphic & Quat'y.
163 Jasper, Fla.	"	148 Cochran.	19 a. Tertiary.
179 Live Oak, Fla.	"	Hawkinsville. ²	"

1. Revised and the notes added by Dr. George Little, State Geologist of Georgia.

2. Buhrstone groups.

3. Northern limit of the open pine and wire grass section.

Central Railroad of Georgia.		Central Railroad of Georgia—Continued.	
Ms.		Ms.	North and South Railroad.
0 Savannah.	19 c. Tertiary.	100 Columbus. ⁴	Metamorphic & Quat'y.
50 Halcyondale. ⁵	19 a. Tertiary.	108 Cleghorn.	Metamor. & Low. Silur.
62 Ogeechee.	"	120 Kingsboro.	"
79 Millen. ⁵	"	Upson County Railroad.	
134 Tennille.	19 a. Tertiary.	0 Macon. ⁴	Metamorphic & Quat'y.
154 Toombsboro.	"	43 Barnesville.	Metamor. & Low. Silur.
170 Gordon.	"	51 The Rock.	"
192 Macon. ⁴	Metamorphic & Quat'y.	59 Thomaston.	"
79 Millen.	19 a. Tertiary.	Georgia Railroad.	
100 Waynesboro.	"	0 Augusta.	
132 Augusta. ⁴	Metamorphic & Quat'y.	38 Thomson.	Metamor. & Low. Silur.
179 Gordon.	19 a. Tertiary.	47 Camak.	"
187 Milledgeville.	20. Quat'y & Metamorp.	57 Barnett.	"
208 Eatonton.	2-4. Low. Silu. Metam.	65 Crawfordville.	"
0 Macon. ⁴	Metamor. & 20. Quat'y.	76 Union Point.	4 c. Cincinnati & Metam.
25 Forsyth.	" 3-4. Low. Silur.	84 Greensboro.	2-4. Lower Silurian.
41 Barnesville.	" "	104 Madison.	"
59 Griffin.	" "	130 Covington.	"
67 Fayette.	" "	141 Conyers.	"
76 Lovejoy's.	" "	147 Lithonia.	"
80 Jonesboro.	" "	156 Stone Mountain ⁶	"
96 East Point.	" "	165 Decatur.	"
103 Atlanta. ⁵	" "	171 Atlanta.	Asbestos, 3 miles.
South-Western Railroad.		0 Camak.	2-4. Lower Silurian.
0 Macon. ⁴	Metamorphic & Quat'y.	Warrenton.	"
8 Seago.	20. Quaternary.	Sparta.	"
29 Fort Valley.	19 a. Tertiary.	Milledgeville.	"
49 Montezuma.	"	78 Macon.	{ 3 miles Artope's quar- ry, Lyell's Eocene fos- sils and Quaternary.
60 Anderson. ⁶	"	57 Barnett.	2-4. Lower Silurian.
71 Americus.	"	75 Washington.	"
83 Smithville.	"	78 Union Point.	2-4. Lower Silurian.
96 Leesburg.	"	Lexington.	"
107 Albany. ⁵	" Buhrstone.	116 Athens.	{ State University and Agricultural College.
Walker's.	" "	Atlanta and West Point Railroad.	
Ducker.	" "	0 Atlanta.	Metamor. & Low. Silur.
Arlington.	" "	6 East Point.	"
29 Fort Valley.	19 a. Tertiary.	18 Fairburn.	"
50 Butler.	20. Quaternary.	25 Palmetto.	"
70 Geneva. ⁴	"	40 Newnan.	R. R. to Carrollton.
75 Box Spring.	"	52 Grantville.	{ Gold mine, 3 miles. Metam. & Low. Silur.
78 Upatoi. ⁴	Metam. 3-4. Low. Silur.	58 Hogansville.	"
100 Columbus. ⁷	Metam. and Quaternary.	72 La Grange.	{ Asbestos & Chromic Iron, 7 miles.
29 Fort Valley.	19 a. Tertiary.	87 West Point.	{ Metam. & Low. Silur. Asbest. & Corundum.
42 Perry.	"		
83 Smithville.	19 a. Tertiary.		
98 Dawson.	"		
118 Cuthbert.	"		
133 Hatchie Station.	18 c. Cretaceous		
142 Georgetown.	"		
144 Eufaula, Ala.	"		
157 White Oak, Ala.	"		
165 Clayton, Ala.	"		
120 Junction.	19 a. Tertiary.		
128 Coleman.	"		
132 Fort Gaines.	"		

4. Located on the line of Metamorphic and Quaternary.

5. Strangers should visit the Geological Collection Room in Capitol Building, Office in room 12.

6. View of old Prison Stockade and U. S. Cemetery east of railroad.

7. Fine falls, Lover's Leap and rapids, on Chattahoochee River.

8. Stone Mountain—a mass of granite—height 1,686 feet.
9. Toccoa Falls, 2 miles, 185 feet. Tallulah Falls, 15 miles distant, nearly 400 feet high.
10. From this point a fine view of Yonah Mountain and the Blue Ridge chain. Clarkesville, 8 miles; Nacoochee Valley, 15 miles; Nacoochee gold mines, 20 miles.
11. Point of departure for Dahlonega gold mines and Porter's Springs.
12. Ladd's mine, 3 miles; Rockmart quarries, 20 miles; and a ferro manganese furnace, 11 miles.
13. Yonah Mountain, 15 miles; Elberton mill site, 20 miles; Toccoa Falls, 5 miles.
14. Conglomerate here and at Rowland Springs, also 5 miles from Cartersville. Flexible sandstone 13, and manganese 3 and 10, and iron ore beds 3, 5, 7 and 10 miles.

Kentucky.¹GEOLOGICAL FORMATIONS FOUND IN KENTUCKY.²

20 b. Alluvium and Bluff. 20 a. Gravel, (equivalent of Orange Sand of Tennessee). 19. Tertiary, (its details not yet studied). 14 c. Upper Coal Measures. 14 b. Lower Coal Measures. 14 a. Millstone Grit. 13 c. Chester. 13 b. St. Louis l. s. (Warsaw at base).		13 a. Keokuk and Waverly. 10 c. Black Shale. { 9 c. Corniferous or Upper Helderberg. 9 a. Cauda Galli. 5 c. Niagara. 4 c. Cincinnati. 4 a. Trenton.	
Louisville, Cincinnati and Lexington Railroad.		Louisville, Cincinnati and Lexington Railroad—Continued. Mount Sterling Line.	
Ms.		Ms.	
0	Louisville.		
	{ 10 c. Genesee. 9 c. Corniferous. } Falls.	28	Lexington Jun.
	{ 5 c. Niagara. 9 c. Corniferous. }	32	Jericho.
7	Woodlawn.	35	Smithfield.
10	Ormsby's.	40	Eminence.
13	Shelbyville Jun.	44	Pleasureville.
16	Pewee Valley.	49	Christiansburgh
27	Lagrange.	52	Bagdad. ³
28	Lexington Jun.	60	Benson.
33	Pendleton.		
36	Sulphur.	65	Frankfort. ⁴
41	Campbellsburg.		{ Town. River runs in 4 a. Trenton.
51	Carrollton.	73	Ducker's.
55	Worthville.	80	Midway.
59	Eagle.	83	Payne's.
62	Liberty.	87	Yarnallton.
65	Sparta.	90	Georgetown.
70	Glencoe.	94	Lexington.
78	Zion.	102	Athens Depot.
84	Verona.	107	Pine Grove.
89	Walton.	112	Winchester.
93	Bank Lick.	120	Hedges.
98	Independence.	127	Mt. Sterling. ⁵
102	Maurice.		
105	South Covington		
109	Newport.		

1. By Mr. John R. Procter, assistant of Prof. N. S. Shaler, State Geologist of Kentucky.

2. The geological survey is in progress, and the formations of the State are not fully determined.

3. Bagdad. To the south of Bagdad can be seen an isolated knob, which is capped with the Niagara group.

4. Frankfort. The Kentucky River runs in Trenton at this point. It reaches up the bank of the river above the town, as high as the railroad tunnel.

5. Mount Sterling. From here can be seen to the eastward, hills capped with St. Louis limestone, and the Conglomerate sandstone at base of Coal Measures.

6. Shepherdsville. Salt River at this point probably cuts down to the Corniferous limestone.

7. Colesburg, at base of Muldraugh's Hill. This hill extends around Central Kentucky, from the mouth of Salt River on the west to the confines of Lewis and Mason counties on the east, retaining nearly for entire length of the great circle the same geological formations, viz; Black shale at base; Keokuk or Waverly shales; Keokuk limestones, becoming more silicious to the eastward, until merged into the shales and sandstones of the Waverly group in Eastern Kentucky; and on to the St. Louis limestone. Excepting in Madison County, where the hill attains its greatest height (1650 feet above sea), it is capped with the Conglomerate sandstone, with a workable sub-conglomerate coal.

Louisville, Cincinnati and Lexington Railroad—Continued.			Louisville, Nashville & Great Southern and North & South Alabama Railroad—Cont.		
Ms.	Shelbyville Division.		Ms.	Knoxville Division.	
0	Louisville.	(As before).	0	Louisville.	(As before).
12	Anchorage.	5 c. Niagara.	30	Lebanon Junc.	{ 10 c. Black shale and 13 a. Lower Sub-Carboniferous.
17	Taylor's.	4 c. Cincinnati.	35	Boston.	10 c. Blk. shl. & 9 c. (?)
23	Simpsonville.	"	45	New Haven.	" Cor.
31	Shelbyville.	"	50	New Hope.	"
Louisville, Nashville & Great Southern and North & South Alabama Railroad.			Louisville and Memphis Division.		
0	Louisville.	9 c. Corniferous.	0	Louisville.	9 c. Corniferous.
6	Strawberry.	10 c. Black shale.	6	Strawberry.	10 c. Black shale.
9	Old Deposit.	"	9	Old Deposit.	"
14	Brooks.	13 a. Lower Sub-Carb.	14	Brooks.	13 a. Lower Sub-Carb.
18	Shepherdsville.	5 c. Niagara.	18	Shepherdsville.	5 c. Niagara.
22	Bardstown Jun.	"	22	Bardstown Jun.	"
25	Belmont.	" & 9 c. Cornif.	25	Belmont.	" & 9 c. Cornif.
30	Lebanon Junc.	{ 10 c. Black shale and 13 a. L. Sub-Carbonif.	30	Lebanon Junc.	{ 10 c. Black shale and 13 a. L. Sub-Carbonif.
34	Colesburg. ⁷	13 a. Lower Sub-Carb.	34	Colesburg. ⁷	13 a. Lower Sub-Carb.
42	Elizabethtown.	{ 13 b. St. Louis group & Upper Sub-Carbon.	42	Elizabethtown.	{ 13 b. St. Louis group & Upper Sub-Carbon.
50	Glendale.	"	50	Glendale.	"
59	Upton.	"	59	Upton.	"
66	Bacon Creek.	"	66	Bacon Creek.	"
73	Munfordville.	"	73	Munfordville.	"
82	Horse Cave.	"	82	Horse Cave.	"
85	Cave City.	"	85	Cave City.	"
91	Glasgow Junc. ⁸	"	91	Glasgow Junc. ⁸	"
96	Rocky Hill.	"	96	Rocky Hill.	"
100	Smith's Grove.	"	100	Smith's Grove.	"
109	Bristow.	"	109	Bristow.	"
114	Bowling Green.	"	114	Bowling Green.	"
118	Memphis Junc.	"	118	Memphis Junc.	"
123	Rockfield.	"	123	Rockfield.	"
132	Auburn.	"	132	Auburn.	"
136	McLeod.	"	136	McLeod.	"
143	Russellville.	"	143	Russellville.	"
148	Cave Spring.	"	148	Cave Spring.	"
157	Allensville.	"	157	Allensville.	"
164	Guthrie.	"	164	Guthrie.	"
(Continued in Tennessee).			Bardstown Branch.		
Louisville and Montgomery Division.			0	Louisville.	9 c. Corniferous.
0	Louisville.	(As before).	22	Bardstown Jun.	5 c. Niagara.
118	Memphis Junc.	13 b. Upper Sub-Carb.	27	Big Spring.	"
125	Woodburn.	"	33	Samuel's.	"
134	Franklin. ⁹	"	39	Bardstown.	"
144	Richland.	"	Richmond Branch.		
			105	Richmond Jun.	4 c. Cincinnati.
			113	Lancaster.	"
			122	Lowell.	"
			128	Silver Creek.	"
			133	Duncannon.	"
			139	Richmond.	"

The Chester group is also represented in this portion of the hill. Muldraugh's Hill represents the retreating escapement of the rocks extending over Central Kentucky.

8. Glasgow Junction. Cavernous limestone of the St. Louis group. The nearest station to the Mammoth Cave. This celebrated cavern and all the other Kentucky caves are in the 13 b. St. Louis division of the Sub-Carboniferous limestone. The knobs seen to the northward are composed of St. Louis limestone, capped with the sandstone of the Chester group, known in Kentucky Geological Reports as the "Big Clifty Sandstone," so named from Big Clifty Creek (Paducah & Elizabethtown Railroad), where it has its greatest development. Glasgow, near the division between the Lower St. Louis and Keokuk groups. Near Glasgow are profitable oil wells.

9. Franklin, near the division between the Lower St. Louis and the Keokuk limestone.

10. From 55 Chicago to 104 Stanford all the formations, from the top of the 4 c. Cincinnati, 9. Corniferous, 10 c. Genesee, and 13. Keokuk, are represented. The Niagara is wanting. The railroad runs on the Cincinnati and Black shales, and the Keokuk knobs strike it on the south. Knobs to right of road (going from Louisville), outliers from Muldraugh's Hill. (See Note 7 (Colesburg) on Louisville and Memphis division. Also see Note 8.

Ms. | Paducah and Memphis Railroad.

0 Paducah. ¹²	20. Post Tertiary.
5 Bond's.	"
9 Florence.	"
14 Boaz.	"
20 Hickory.	"
26 Mayfield.	"
32 Pryor's.	"
37 Wingo.	"
44 Moree.	"
50 Fulton.	"

(Continued in Tennessee).

Kentucky Central Railroad.

0 Covington.	4 c. Cincinnati.
7 Culbertson.	"
14 Canton.	"
21 Mullin's.	"
25 Demossville.	"
31 Boston.	"
39 Falmouth.	"
47 Morgan.	"
53 Berry's.	"
58 Garnett.	"
66 Cynthia.	"
70 Lair. ¹³	"
73 Shawhan.	"
80 Paris.	"
89 Lowe.	"
99 Lexington.	"
106 Providence.	"
112 Nicholasville.	"

Maysville and Lexington Division.

0 Maysville.	4 c. Cincinnati.
9 Marshall.	"
13 Helena.	"
16 Johnson.	"
18 Elizaville.	"
20 Ewing.	"
28 Myers.	"
33 Carlisle.	"
41 Millersburg.	"
50 Paris.	"

Evansville, Owensboro and Nashville R. R.

0 Owensboro.	14. Carboniferous.
7 Sutherland.	"
15 Riley's.	"
21 Livermore.	"
27 Strouds.	"
35 Owensboro Jun.	"

Ms. | St. Louis & South-Eastern Railroad.

0 St. Louis.	(See Missouri).
171 Henderson.	14. Carboniferous.
181 Busby's.	"
188 Sebree.	"
198 Slaughtsville.	"
209 Madisonville.	"
221 Nortonville.	"
232 Crofton.	13 b. Upper Sub-Carb.
245 Hopkinsville.	"
255 Pembroke.	"
261 Trenton.	"
269 Guthrie.	"

Chicago, St. Louis & New Orleans Railroad.

0 Cairo.	19. Tertiary (?).
7 Fort Jefferson.	"
20 Arlington.	"
28 Clinton.	"
36 Alexander.	"
42 Fulton.	"

(Continued in Tennessee.)

Mobile and Ohio Railroad.

0 Columbus. ¹⁴	19. Tertiary (?).
8 Clinton.	"
13 Moscow.	"
16 Cayce's.	"

(Continued in Tennessee.)

Louisville, Paducah & South-Western R. R.

0 Louisville.	9 c. Corniferous.
8 Pleasant Ridge.	13 b. Upper Sub-Carb.
18 River View.	"
26 Muldraugh.	"
46 Cecilian Junc'n.	" Chester.

Paducah & Elizabethtown Railroad.

0 Elizabethtown.	13 b. St. Louis & 13 a.
6 Cecilian Junc'n.	"
10 Stephensburg ¹⁵	13. Sub-Carbon. l. s.
13 East View.	"
21 Big Clifty. ¹⁶	" Chester & S.L.
27 Grayson Springs	"
31 Litchfield. ¹⁷	" Chester.
37 Millwood.	" and 14.
43 Caneyville.	14. Carboniferous.
47 Spring Lick.	"
50 Horse Branch.	"
60 Rosine.	"
63 Elm Lick.	"
68 Beaver Dam.	"
70 Hamilton.	"

11. Muldraugh's Hill crossed before reaching Crab Orchard. See Note 7. Canda Galli fossils were found at Crab Orchard by Mr. Procter. There are fine specimens in the State cabinet.

12. Paducah. At this point is an extensive deposit known as the Paducah Gravel Beds, affording, perhaps, the most superior road metal to be found in this country. This gravel is composed of the waste from the degraded beds to the eastward, and is principally quartz pebbles from the Conglomerate, and rounded fragments of chert from the Keokuk and St. Louis groups, with coarse angular sand—all quite ferruginous. When properly put down on streets or roads it soon cements, and does not yield to the heaviest hauling, needing little after repairs, and affording a smooth, hard street. It also affords a superior material for concrete.

13. Lair Station. Near the road, half mile south of station, to west of road, there is an opening in a fissure vein, 30 inches wide, well filled with baryta, containing Galena, and zinc.

Paducah and Elizabethtown Railroad— <i>Continued.</i>			Ms.	Eastern Kentucky Railroad— <i>Cont.</i>	
76 Rockport.	14 c. Upper Coal Mres.		10½	McAllister's.	14 b. Lower Coal Mres.
77 Green River.	" Mines.		12½	Hunnewell. ²⁸	"
80 Nelson Creek.	"		15½	Deming's.	"
86 Owensboro Jn. ¹⁸	"		16½	Hopewell. ²⁹	"
88 Muhlenberg.	" Mines.		18½	Anglius.	"
93 Greenville.	"		21	Pactolus. ³⁰	"
98 Gordon.	"		23	Grayson. ³¹	"
103 Bakersport.	"		26	Vincents.	"
110 Norton Junc. ¹⁹	"		28	Mt. Savage. ³²	"
117 Woodruff. ²⁰	"		29½	Reedville.	"
125 Tradewater. ²¹	14 a. Millstone Grit.		34	Willard. ³³	"
134 Scottsburg. ²²	13 b. Sub-Carb. St. Los.		Cincinnati Southern Railroad.		
139 Princeton.	"			Cincinnati.	4 b. Cincinnati.
145 Dulaney.	"		0	Ludlow.	"
151 Eddyville.	"		5	Kenton Heights.	"
152 Kuttawa. ²³	13 c. Keokuk?		6	Greenwood Lake	"
158 Cumberland Riv	"		11	Dixon.	"
163 St. Bernard.	"		14	Richwood.	"
168 Calvert City.	20. Post Tertiary.		17	Walton.	"
176 Lawton's Bluff.	"		21	Bracht.	"
179 Clark's River.	"		25	Crittenden.	"
187 Paducah. ¹²	"		28	Sherman.	"
Eastern Kentucky Railroad. ²⁴			32	Dry Ridge.	"
0 Riverton. ²⁵	14 b. Lower Coal Mres.		35	Williamstown.	"
3 Three Miles.	"		39	Mason.	"
5 Worthington. ²⁶	"		44	Blanchet.	"
6½ Argillite. ²⁷	"		46	Corinth.	"
9 Laurel.	"		49	Hinton.	"

14. Columbus. Interesting point. Bluffs 200 feet high, composed of clays and sands. At base of bluff is a pure white sand, extending to about high water mark. Also excellent glass sand above this, and superior fire and potters' clay. Near top of bluff quite a thickness of gravel, equivalent of the Paducah gravel. (See Paducah, Note 12).

15. Stephensburgh. About 1½ miles west of this place St. Louis limestone comes to the surface and continues, determining the topography and character of the soil to Elizabethtown.

16. Big Clifty. The bluffs at Big Clifty Creek are composed of thick sandstone, base of the Chester, resting on top of the St. Louis group of Sub-Carboniferous limestone.

17. Litchfield. Sandstone here, base of the Chester group. Near this point are to be found the Litchfield marls, rich in potash and phosphoric acid.

18. Owensborough Junction. Coals A and B near level of road bed.

19. Norton. Fault here. Coal D (No. 9) west and Coal A (No. 12) and B (No. 11) east of Norton.

20. Woodruff Station. St. Charles Mines. Coal D (No. 9).

21. Tradewater Station. Coal L. (No. 1, B), about 25 feet above road bed.

22. Scottsburg. The hills around Scottsburg are capped with sandstone, base of the Chester group; 2½ miles east of Scottsburg the cuts through which the road runs expose the Chester group, limestones and marly shales, the latter rich in potash; 3½ miles east of Scottsburg the Conglomerate sandstone, base of the Coal Measures, is seen.

23. Kuttawa. Three miles west of this station the road cuts through a thick deposit of excellent limonite iron ore: to be seen on north side of cut.

24. This railroad runs through the heart of the Kentucky division of the Hanging Rock Iron Region. On the line of the road all of the coals are to be found, from No. 1 to No. 11, and most of the iron ores.

25. No. 1 Coal near water level.

26. No. 3 Coal in the hills, about 150 feet above grade of road.

27. Near site of Old Argillite Furnace, probably the oldest furnace in the Hanging Rock Iron Region, erected in 1822. About 3 miles east of station is the Pennsylvania Furnace, and 3 miles west the Buffalo Furnace.

28. Hunnewell Furnace located here; also the machine and repair shops of the railroad. Mines of No. 8 and No. 4 Coal, the latter known as the Hunnewell Cannel Coal.

29. The former site of an old furnace of that name.

30. The former site of an old furnace of that name.

31. The county seat of Carter County. Coals No. 2 and No. 8 are found here. Iron Hills Furnace, the largest charcoal furnace in this section, is situated about 8 miles northwest from Grayson, where also is the celebrated Lambert Ore Bank, a local deposit, 14 feet 10 inches thick—of great value. Thirteen miles west of Grayson are the celebrated Carter Caves, situated in the St. Louis group of the Sub-Carboniferous limestone. These caves and the wild scenery of Tigart Valley, surrounding them, are well worth visiting.

32. Near here is Mount Savage Furnace, and fine veins of Coals No. 8 and No. 7, the latter known as the Coalton Coal.

Ms. Cincinnati Southern Railroad—Cont.		Lexington and Big Sandy Railroad. Eastern Division.	
54 Sadieville.	4 b. Cincinnati.		
60 Rogers' Gap.	"		
63 Kinkaid.	"	0 Ashland.	{ 14 b. Coal Measures. Iron Works. Coal vein No. 6.
67 Georgetown.	"		
74 Donerail.	"	2 Bellefonte.	{ 14 b. Coal Measures. Furnace 2 miles.
75 Greendale.	"		
78 Lexington.	"	5 Summit.	14 b. Coal Measures.
85 Providence.	"	7 Clinton.	"
90 Nicholasville.	"	9 Russell.	"
95 Scott's.	"		
100 Tower's. ³⁴	"	10 Stewart's Tun- nel.	{ Prince's Furnace. Coal vein No. 7.
106 Durgin.	4 b. Cincinnati.		
107 Harrodsburg Ju	"		
113 Danville.	"	11 Coulton.	{ 14 b. Coal Measures. R. R. Co.'s mines, vein No. 7.
118 Danville Jun. ³⁵	" and 5 c.		
123 Moreland.	10 c. and 13 a.	13 Kilgore.	14 b. Coal Measures.
128 McKinney.	"	14 Rush.	"
128 South Fork.	"		
136 King's Mt. ³⁶	13 a. Upper Sub-Carb.	13 Kilgore.	"
143 Eubanks.	13 b. Lower Sub-Carb.		
150 Science Hill.	"	14 Star.	{ Coal vein No. 7. Norton's Iron Works.
158 Somerset.	"		
Nashville, Chattanooga and St. Louis Railroad.			
0 St. Louis, Mo.	(See Missouri.)		
177 Hickman, Ky. ³⁷	{ 19. Tertiary and 20. Post Tertiary.		
184 State Line.	"		
(Continued in Tennessee).			

33. At Willard are the ores and coal mines of the Bellefonte & Etna Company of Ironton, Ohio. Most of the coals are represented in this vicinity.

34. Crossing of Kentucky River, said to be the highest railroad bridge in the world, being 270 feet above the water. The scenery is very grand. The base of the hills is 4 a. Trenton limestone, affording fine building stones known as Kentucky River Marble, a fine grained magnesian limestone, of soft buff color, susceptible of a high polish, easily wrought, and of great strength and durability.

35. Probably the top of 4 b. changes rapidly here; bluffs near here, composed principally of 13 a., with 10 c. at the base.

36. Tunnel 4,000 feet, through a continuation of Muldraugh's Hill. Tunnel in 13 a. Keokuk fossils in the shales, hills capped with 13 b. See Note 7.

37. See Notes 13 and 14.

Tennessee.¹

List of Geological Formations found in Tennessee:

DANA'S TABLE OF FORMATIONS.		TENN. DIVISIONS, By Prof. Safford.	DANA'S TABLE OF FORMATIONS.		TENN. DIVISIONS, By Prof. Safford.
20.	Quaternary.	20 c. Alluvium.	7.	Lower Helderberg.	7. Lower Helderberg.
"	"	20 b. Bluff loam.	5.	Niagara.	5 d. Niagara limestone
"	"	20 a. Orange s. or dft.	"	Clinton.	5 c. Dyestonc Group.
19.	Tertiary Eocene.	19 b. La Grange sand.	"	Medina.	5 b. White Oak Mt. ss.
"	"	19 a. Flatwoods s. & c.	"	"	5 a. Clinch Mt. s. s.
18.	Cretaceous.	18 c. Ripley Group.	4 b.	Cincinnati.	4 b. Nashville.
"	"	18 b. Rotten l. s.	4 a.	Trenton.	4 a. Trenton.
"	"	18 a. Coffee sand.	3.	Canadian. Quebec.	3 c. Knox dolomite.
14.	Carboniferous.	14. Coal Measures.	"	"	3 b. Knox shale.
13.	Sub-carbonifer's	13 c. Mount'n l. s.	"	Calcifer's.	3 a. Knox sandstone.
"	"	13 b. Coral or St. L. l. s.	2.	Primord'l. Potsd'm	2 b. Chilhowe s. s.
"	"	13 a. Barren Group.	"	Acadian.	2 a. Ocoee Group.
10.	Hamilton.	10 c. Black Shale.	1.	Archæan.	1. Metamorphic?

Ms. 1 Paducah and Memphis R. R.		Probably resting on sub-carb. l. s. (Chester?)	Ms. Mobile and Ohio—Continued.	
0	Paducah, Ky.		87	Jackson.
5	Bond's.		89	Pinson.
9	Florence.		103	Henderson.
14	Boaz.		114	McNairy.
16	Viola.		{	18. Cretaceous.
20	Hickory.			18 c. Ripley group.
26	Mayfield.			"
32	Pryor's.		132	Ramer, Tenn.
37	Wingo.		143	Corinth, Miss.
44	Morse.		3 New Orleans, Louisville and Chicago R.R.	
50	Fulton.		0	New Orleans.
53	Pierce, Tenn.	19 b. La Grange sand.	382	Lamar, Tenn.
56	Harris.	"	394	Grand Junct'n.
59	Paducah Jun.	"	{	19. Tertiary, or
63	Troy.	"		19 b. La Grange group
68	Polk's.	20. Quaternary. Bluff.		"
74	Obion.	"	413	Bolivar.
78	Trimble.	"	441	Jackson.
2 Mobile and Ohio R. R.			455	Medina.
0	Columbus, Ky.	{ 20. Quaternary.	464	Milan.
		{ 20 b. Bluff loam 10 m.	475	Bradford.
7	Clinton.	"	481	Greenfield.
43	Moscow.	"	487	Sharon.
16	Cayee's.	19. Tertiary, or	495	Frost.
20	Jordan, Ky.	19. b. La Grange group.	550	McConnellville
26	Union City, Tn.	"	506	Fulton, Ky.
31	Troy.	"	4 Louisville and Nashville and Great Southern Railroad.	
45	Crockett.	"	0	Louisville, Ky.
43	Kenton.	"	164	Guthrie, Tenn.
48	Rutherford.	"	168	Hampton's.
52	Dyer.	"	171	Dudley's.
59	Trenton.	"	177	Clarks ville.
70	Humboldt.	"	184	Steele's.
79	Carroll.	"	189	Palmyra.
			190	Carbondale.

1. Revised and the notes added by Prof. James M. Safford, the State Geologist of Tennessee, and the portion in Kentucky by Prof. N. S. Shaler, the State Geologist of Kentucky.

Ms.—Louisville and Nashville and Gt. S.— <i>Con.</i>			Ms Louisville and Nashville and Gt. S.— <i>Con.</i>		
198 Cumberland. ^a	13 a. Lower car. (silic's)		223 Carter's Creek.	4 a. Trenton.	
205 Erin.	"		233 Columbia.	"	
210 Tenn. Ridge.	"		243 Pleasant Grove	"	
214 Stewart's.	"		246 Campbell's.	"	
220 Tenn. River.	{ 5. Niagara, and		251 Lynnville.	"	
230 Big Sandy.	{ 7. lower Heldrb. 12 m.		254 Buford's.	"	
235 Springville.	"		256 Reynold's.	"	
241 Porter's.	{ 18. Cretaceous, and		261 Wales.	"	
246 Paris.	{ 19. Tertiary, 11 miles.		266 Pulaski.	"	
	"		272 Harwell.	"	
	(Memphis Division.)		273 Aspen Hill.	"	
256 Henry.	19 b. La Grange Group.		275 Lester's.	"	
264 McKenzie.	"		278 Prospect.	"	
274 Trezevant.	"		280 State Line.	4 b. Cincinnati.	
284 Milan.	"		286 Elkmont, Ala.	13. Sub-carboniferous.	
296 Humboldt.	"			(Continued in Alabama.)	
301 Gadsden.	"		5 Memphis and Charleston R. R.		
308 Bell's.	"		0 Memphis, Ten.	20 b. Bluff loam or Q ^{rt} .	
312 Jones's.	"		5 Buntyn.	"	"
321 Brownsville.	"		9 White s.	"	"
329 Shephard.	"		15 Germantown.	"	"
333 Stanton.	"		19 Bailey.	"	"
341 Mason.	"		23 Collierville.	"	"
349 Galloway.	"		31 { Rossville, or	19 b. La Grange.	
352 Withe	{ 20 b. Quarternary.		La Fayette.	"	
358 Shelby.	{ (Bluff loam) 24 miles.		39 Moscow.	"	
366 Bartlett.	"		52 Somerville.	"	
377 Memphis.	"		49 La Grange.	"	
	(Division to Nashville and Montgomery.)		52 Grand Junc.	"	
0 Louisville, Ky.			58 Saulsbury.	"	
114 Bowling Green	13 a. Lower sub-carb'fs.		64 64 mls. Siding.	19 a. Flatwoods.	
118 Memphis Jun.	"		69 Middleton.	18. Cretaceous.	
122 Rich Pond.	"		74 Pocahontas.	"	
125 Woodburn.	"		79 Big Hill.	"	
134 Franklin.	"		84 Chewalla.	"	
141 Mitchellville, T.	{ 13 a. lower sub-carb'f.		93 Corinth, Miss.	"	
144 Richland.	{ (Silicious.)		107 Burns ville.	"	
146 Fountain Head	"		115 Iuka.	"	
149 Buck Lodge.	"		124 Marguren, Ala.	13. Sub-carboniferous.	
153 (Tunnel). ^a	4 b. Cincinnati or Nashv.		127 Dickson.	"	
159 Gallatin.	"		129 Cherokee.	"	
164 Pilot Knob.	"			(Continued in Alabama.)	
166 Saundersville.	"		6 St. Louis and South-Eastern R. R.		
170 Hendersonville	"		0 St. Louis.		
175 Edgefield Jun.	{ 4 b. Cincin't. or Nash-		261 Trenton.		
178 Madison.	ville, and 4 a. Tren.		269 Guthrie.	13. Sub-carboniferous.	
184 Edgefield.	4 b. Cincinnati or Nashv.		274 Forts.	"	
185 NASHVILLE.	"		280 Cedar Hill.	"	
189 N. and C. Jun.	"		287 Springfield.	"	
197 Brentwood.	4 b. Cincinnati or Nashv.			{ 5 a. Niagara, with blk.	
206 Franklin.	"		299 Baker's.	shale above. A	
215 Thompson's.	"			good section here.	
219 Ewell's.	"		303 Goodlett's.	4 b. Nashville.	
			306 Edgefield Jun.	4 b. Nashv. & 4 a. Trent.	
			309 Madison.	4 b. Nashville.	
			315 Edgefield.	"	
			316 NASHVILLE.	"	

3. At this Tunnel is a good section of the (10 c.) Black Shale, with the strata above and below.

2. Very soon after leaving Cumberland, the road enters the *Wells Creek Basin* and crosses the 10 c. Black Shale, also 7 Lower Helderberg, 5 d. Niagara, 4 a. Trenton, 4 b. Nashville, and 3 c. Knox Dolorite strata, which have been brought to the surface by an uplift. In the bluff on the river just below Cumberland are good presentations of the 10 c. Black Shale, as well as the 5 Niagara and 7 Lower Helderberg rocks.

Ms. 7 Nashville, Chatanooga and St. Louis.			Ms. 8 Tennessee and Pacific R. R.		
0	CHATANOOGA.	{ 4 a. Trenton, and 3 c. Knox dolomite or Quebec. ⁴	0	NASHVILLE.	4 b. Nashville.
6	Wauhatchie.	4 b. Nashville.	2	Mt. Olivet.	4 b. Nash. and 4 a. Tren.
13	Ætna Cl. Mines	{ 13 c. Upper sub.carb.	8	Donelson.	4 a. Trenton.
14	Whitesides.	{ 14. Coal Measure Mts. near by.	12	Hermitage.	"
22	Shellmound.	Alluvium (Ten. R. Bot'm)	18	Mt. Juliet.	"
28	Bridgeport.	3 c. Knox dolm. or Queb.	24	Leeville.	"
39	Stevenson.	{ 3 b. Knox shale—sub-carboniferous near by.	26	Tucker's Gap.	4 b. Nashville.
49	Anderson.	13. Sub-carboniferous.	31	LEBANON.	4 a. Trenton.
62	(Tunnel.)	"	9 Shelbyville Branch.		
64	Cowan.	"	0	Chattanooga.	
69	Decherd.	"	96	WARTRACE.	4 b. Nash. and 4 a. Tren.
82	Tullahoma.	"		SHELBYVILLE.	4 a. Trenton.
89	Normandy.	4 b. Nash. or Cincinnati.	10 McMinnville and Manchester R. R.		
96	Wartrac.	4 b. Nash. and 4 a. Trent.	0	Chattanooga.	
101	Belle Buckle.	4 a. Trenton.	82	Tullahoma.	13 a. Lower sub-carb'fs.
109	Christiana.	"	116	McMinnville.	"
119	Murfreesboro.	"	11 Winchester and Alabama R. R.		
126	Florence.	"	0	DECHERD.	13 b. low. carb. (silic's.)
131	Smyrna.	"	3	Winchester.	"
136	Lavergne.	"	10	Belvidere.	"
142	Antioch.	"	16	Hunt's.	"
150	Nash. & Dec. J.	4 b. Nashville.	26	Cunningham.	4 b. Cincin. or Nashville
151	NASHVILLE.	"	28	Brighton.	"
158	Bellemeade, or Harding's.	"	32	Kelso.	"
164	Bellevue.	"	37	FAYETTEVILLE.	"
168	Newsom's. ⁵	"	12 Jasper Branch.		
176	Kingston Sprg.	13. Sub-carboniferous.	28	Bridgeport.	3 c. Knox dolm. or Tren.
189	Burns.	"		Jasper.	13. Sub-carboniferous.
193	Dickson.	"	13 Tennessee Coal and R. R. Co.'s R. R. 6		
208	McEwen.	13 a. Lower sub-carbonif.	0	Chattanooga.	
218	Waverly.	"	62	Tunnel, near Cowan.	13 b. Sub-carboniferous. Mountain limestone.
229	Johnsonville.	{ 10 c. Black shale, and 13. Lower sub-carb'fs.	83	Tracy City.	14. Coal Measures. Seawancee coal mines.
238	Camden.	13. Sub-carboniferous.	6 This R. R., 21 miles long, ascends the Cumberland Mountain table land in a few miles, presenting a fine section of the sub-carboniferous limestone. Near the top of the mountain it intersects the sandstones, shales, &c., of the base of the coal measures. Then, for many miles, it runs on the conglomerate. At Tracy City is a good bed of coal, extensively mined. In this vicinity a good section of the coal measures of this part of Tennessee can be obtained. See "The Coal Regions of America," p. 351 to 373.		
258	Huntingdon.	19 a. Flatwoods Tertiary	14 Knoxville and Ohio R. R.		
270	McKenzie.	19 b. La Grange Tertiary	This Railroad presents fine sections of the formations of E. Tennessee.		
278	Gleason.	"	0	Knoxville.	Knox dolm. and Trenton
285	Dresden.	"	40	Careyville.	{ 14. Coal Measures. Coal beds of the Cumberland Mountain. ⁷
303	Paducah Jun.	"			
307	Union City.	20 b. Bluff loam.			
314	STATE LINE, Tn.	"			
	(Continued in Kentucky.)				
321	Hickman, Ky.	"			
333	Columbus, "				
499	St. Louis, Mo.				

4 Upper Silurian beds, the Black Shale and the lowest carboniferous strata, may also be seen in the high hill on the West side of the city.

5. At Newsom's a section may be conveniently seen extending from the upper part of the 4 b. Nashville to the 13 sub-carboniferous.

7. For a full description of the Coal Fields of Tennessee and those of the other States, see "THE COAL REGIONS OF AMERICA, their Topography, Geology and Development, with numerous maps and illustrations." By James Macfarlane. Published and sold by D. Appleton & Co., New York: 8 vo. pp. 700; \$5.00, sent by mail post paid.

Alabama.¹

DANA'S TABLE OF FORMATIONS.	ALABAMA DIVISIONS BY PROF. GESNER.	DANA'S TABLE OF FORMATIONS.	ALABAMA DIVISIONS BY PROF. GESNER.
20. QUATERNARY.	20 c. Alluvium.	10 c. GENESEE.	10 c. Black Shale.
"	20 b. Bluff Loam.	7. LOW. HELDERB'G.	7. Lower Helder'g.
19. TERTIARY.	20 a. Orange s. or dt.	5. NIAGARA.	5 d. Niagara l. s.
"	19 c. Pliocene.	5. CLINTON.	5 c. Dyestone Group
"	19 b. Miocene.	5. MEDINA.	5 b. Wh. Oak Mt. s. s.
"	19 a. Eocene.	"	5 a. Clinch Mt. s. s.
18. CRETACEOUS.	18 c. Upper Cretac's.	4. TRENTON.	4 b. Cincinnati.
"	18 b. Middle Creta's.	"	4 a. Trenton.
"	18 a. Lower Creta's.	3. CANADIAN.	3 c. Chazy.
17. JURASSIC.	17 b. Marlstone.	"	3 b. Quebec Knox dolomite.
"	17 a. Lower Lias.	"	3 a. Calciferous.
14. CARBONIFEROUS.	14 c. Up. Coal Mrs.	2. PRIMORDIAL OR CAMBRIAN.	2 b. Potsdam s. s.
"	14 b. Low. Coal Mrs.	"	
"	14 a. Millstone Grit.	1. ARCHÆAN.	2 a. Acadian.
13. SUB-CARBONIF.'S.	13 b. Mountain l. s.	"	1 b. Huronian.
"	13 b. Coral or St. L. ls		1 a. Laurentian.
"	13 a. Barren Group.		

South and North Alabama, or Louisville and Ms. Great Southern Railroad.		South and North Alabama, or Louisville and Ms. Great Southern Railroad—Continued.	
0 Decatur.	13 b. U. Carb. or Mt. Ls.	90 Grace's Gap. ⁶	(See foot note.)
7 Flint.	"	93 Oxmoor.*	14 c. Cahawba coal field.
13 Hartsell's.	"	95 Shade Creek.	"
18 Falkville.	"	99 Brock's.	"
23 Wilhite's.	"	102 Cahaba Mines. ⁶	"
28 Summit. ²	14 b. War'r coal	104 Helena. ⁷	{ 3 a. Calcifer'us fault.
31 Milner's.	" field.	109 Siluria.	{ 14 b. Coal Measures.
33 Cullman's.	"	112 Whiting's.	3 c. Chazy & Tren. (Lime Wks.)
35 Phelan's.	"	119 Calera Hills.	{ 13 Sub-Carbon., 3 c.
42 Hanceville.	"	125 Clear Creek.	{ Chazy & 4 a. Tren.
49 Bangor.	"	130 Jemison.	1 b. Metamorphic.
52 Blount Springs ³	{ 13 b. Up. Sub. Carb.	135 Strasburg.	"
	{ 13 a. Low. Sub. Carb.	139 Lomax.	"
	{ 10 c. Black Shale.	141 Clanton.	"
57 Reid's.	14 b. Warrior coal field.	148 Cooper's.	"
63 Warrior. ⁴	"	151 Verbena.	"
68 Morris.	" Jeffer. Cl. Co.	155 Mountain Creek	20. Quaternary.
74 Cunningham.	" [Co.	164 Deatsville.	"
76 New Castle.	" N. C. Coal & I.	170 Elmore.	"
79 Black Creek.	Coalburg Co.'s colliery.	174 Coosada.	"
81 Boyle's.	14 b. Warrior coal field.	179 Alabama River.	18. Cretaceous.
	{ 4 a. Trenton.	Commerce St. Ju	"
	{ 3 c. Chazy.	182 Montgomery.	"
	{ 3 b. Quebec.		
	{ 3 a. Calcifer.		

1. Prepared expressly for this work by Prof. William Gesner, of Birmingham, Ala., Geologist and Analytical Chemist, and by Prof. Eugene A. Smith, the State Geologist.

2. Ascending the mountain from Wilhite's to Summit, Flint Creek shows looming above it cliffs of millstone grit, sandstone and shales, as seen from the car windows. W. G.

3. White and red sulphur and Chalybrate waters of great sanitary value at Blount Springs are much resorted to, particularly in the summer season, from all the States; and the Jackson House, by S. D. Holt, is a well kept hotel. The 10 c. Black Shale gives rise to the sulphur springs. The mountains on each side are 14 a. Carboniferous. W. G.

4. The Pierce Coal Mine Company and Alabama M. & M. Company's mines here. W. G.

* Eureka furnaces and coke ovens.

Selma, Rome and Dalton Railroad, or, Blue Mountain Route.		Alabama and Chattanooga Railroad—Con- tinued.	
Ms.		Ms.	
0 Selma.	18. Cretaceous.	26 Rising Fawn.	4 c. Cincinnati & 4 a. Trent.
9 Burnsville.	"	28 Cloverdale.	"
22 Plantersville.	20. Quaternary.	32 Sulphur Springs	"
32 Maplesville.	"	34 Eureka.	14 b. Warrior coal field.
40 Randolph.	"	40 Valley Head.	"
49 Ashby.	"	46 Hollman's.	"
51 Briarfield. ⁸	3 b. Knox Dolomite.	51 Fort Payne.	"
55 Montevallo. ⁹	3 a. Calciferous, 1 mile.	56 Brandon's.	"
	3 b. Quebec, 5 miles.	61 Porterville.	"
62 Calera.	3 c. Chazy, Trenton & ridge of 18 a. Sub-Car.	65 Collinsville.	"
Gardner's.	14. Coosa coal field.	74 Greenwood.	"
67 Shelby Spr'gs. ¹⁰	"	82 Reases.	"
72 Columbiana. ¹¹	3 b. Quebec or Knox.	87 Attalla.	"
82 Wilsonville.	"	95 Steele's.	"
Coosa River. ¹²	"	102 Whitney or Ashville.	"
Coosa Station.	"	115 Springville.	3 b. Quebec or Knox.
90 Childersburg.	"	131 Trussville.	"
99 Alpine. ¹³	"	137 Irondale.	"
109 Talledega.	"	143 Birmingham.	4 a. Trent. & 3 c. b. & a. of Canadian anti. axis.
(Alabama Furnace.)	"	155 Jonesboro.	3 c. and 3 b. Canadian.
126 Munford.	"	167 Tannehill. ¹⁴	3 b. or 3 a. Canadian.
Silver Run. ¹⁴	"	170 Green Pond.	3 b. Quebec or Knox.
130 Oxford. ¹⁵	"	174 Bibbville.	14 b. Warrior coal field.
131 Anniston.	Woodstock	178 Vances.	"
139 Weaver's.	Iron Wks.	183 Clement's.	"
145 Jacksonville.	"	191 Kennidale.	"
156 Patona.	"	198 Tuscaloosa.	20. Quaternary.
Cross Plains.	"	204 Maxwell's.	"
Ladiga.	Tecumseh	213 Carthage.	"
160 Amberson.	Iron Co.	Stewart's or Havana.	"
164 State Line. ¹⁶	Stonewall Ir.	223 Akron.	18 b. Cretac. rotten l.s.
168 Pryor's, Ga.	Works.	233 Eutaw.	"
170 Cave Springs.	4 a. Trenton.	239 Haysville.	"
172 Rome, Ga.	"	243 Boligee.	"
		250 Epps.	"
		259 Livingston.	"
		263 Hooks.	19 a. Tertiary, 36 miles.
		269 York.	"
		274 Cuba.	"
		279 Kewanee.	"
		283 Toomsaba.	"
		290 Russell's.	"
		295 Meridian.	"

Alabama and Chattanooga Railroad.¹⁸

0 Chattanooga, Tenn. ¹⁹	4 a. Trenton.
6 Wauhatchie.	4 b. Cincinnati.
9 Wildwood, Ga.	4 a. Trenton.
12 Morganville.	"
18 Trenton.	"
23 Dadeville, Ala.	"

5. The prosperous city of Birmingham is in Jones' Valley. The railroad then passes through Red Mountain by Grace's Gap. The rocks of the anticlinal axis show, at the junction of the Lower Carboniferous with the 5 c. Clinton, an exposure of fossiliferous hematite iron ore, 28 feet thick, which is being used in the production of an excellent quality of iron by the Eureka Company, at Oxmoor, at the next station. This bed of iron ore extends from a few miles below Pratt's Ferry on the Cahaba River, in Bibb County, through St. Clair, Cherokee and De Kalb counties, into Tennessee, a distance of 120 miles.

6. S. D. Holt and Davis and Carr's collieries. W. G.
7. Eureka Company's colliery and Central Iron Works Company at Helena. W. G.
8. Branch railroad to Briarfield Rolling Mills and Furnaces. W. G.
9. Cahawba coal field on the west, with branch railroad to the Montevallo coal mines of Dr. T. Aldrich. W. G.
10. Shelby Springs, Chalybrate and sulphuretted Hydrogen water of great renown, and much frequented. W. G.
11. Columbiana branch to Shelby Iron Works. W. G.
12. From Coosa River to Childersburg, mountains of 2 b. Potsdam sandstone are seen to the southeast from car windows. E. A. S.
13. From Alpine to Talledega, 2 b. Potsdam sandstone mountains on the west, and 2 a. Acadian state hills toward the east. E. A. S.
14. At Silver River, 2 a. Acadian on the east, and 2 b. Potsdam on the west. E. A. S.

From Valley Head the R. R. follows the great anticlinal valley on the Shuford and Devonian formations. Above Atlanta the precipitous bluffs of the Millstone Grit may be seen for many miles to the west of the R. R. The stations are in 4 a. Trenton, 4 c. Cincinnati and 3 a. Calciferous.

Ms. Memphis and Charleston Railroad.		Ms. Nashville and Chattanooga Railroad.	
0 Memphis.	20. Quat'ry, bluff loam.	Stevenson Junc.	3 b. Quebec or Knox.
5 Buntyn.	"	Bass Station.	"
9 White's.	"	49 Anderson.	13 a. Sub-Carbonifer.
15 Germantown.	"	39 Stevenson.	3 b. Quebec or Knox.
19 Bailey's.	{ 19. Tertiary, orange	29 Bridgeport.	3 c. Canadian.
23 Collierville.	sand LaGrange group.	22 Shellmound.	20. Quat'ry, Alluvium.
31 La Fayette.	"	14 Whiteside.	14 b. Coal Mrs. & 13 c.
59 Moscow.	"	(Etna Coal Mines.)	
52 Somerville.	"	6 Wauhatchie.	4 b. Cincinnati.
49 La Grange.	"	0 Chattanooga.	4 a. Tren. & 3 c. Canad.
52 Grand Junction.	"	Nashville and Decatur Railroad.	
58 Saulsbury.	"	0 Decatur.	13 b. Lower Carbonifer.
64 Mile Siding.	19. Tert', Porter's Creek	3 Harris Station.	"
74 Pocahontas.	" group.	13 Athens.	"
79 Big Hill.	18. Cretac's, green sand	22 Elkmont.	"
84 Chewalla.	" group.	Pittsenville.	"
93 Corinth, Miss.	18 c. Ripley group.	27 State Line.	3 b. Quebec or Knox.
107 Burnsville.	"	Western Railroad of Alabama.	
115 Iuka.	13 b. & a. Sub-Carbon.	0 West Point.	1 b. Huronian.
124 Margerum, Ala.	"	11 Cusseta.	"
127 Dickson.	"	13 Mt. Jefferson.	"
129 Cherokee.	"	18 Rough & Ready.	"
133 Barton.	"	22 Opelika.	"
139 Pride's.	13 b. & a. Sub-Carbon.	28 Auburn.	" & 20. Quat'ry.
145 Tusculumbia.	13 a. Lower Carbonifer.	35 Loachapoka.	20. Quaternary.
156 Leighton.	"	42 Notasulga.	"
163 Town Creek.	"	Fisher Branch—(Narrow Gauge to Tuskegee.)	
169 Courtland.	"	48 Chehaw.	20. Quaternary.
176 Hillsboro.	"	(To Tallahassee	Factory), 1 b. Huronian.
182 Trinity.	"	56 Cowles' Station.	20. Quaternary.
188 Decatur.	13 b. Lower Carbonifer.	65 Shorter's.	18. Cretaceous.
195 Mooresville.	"	75 Mt. Meigs.	"
203 Madison.	"	88 Montgomery.	"
212 Huntsville.	{ 3 b. Chazy and 3 b.	101 Manack.	"
223 Brownsboro.	Quebec, hills 14 a.	107 Lowndesboro.	"
229 Gurley's.	Sub-Carboniferous.	113 Whitehall.	"
233 Paint Rock.	"	119 Benton.	"
237 Woodville.	13 a. Sub-Carbonifer.	127 Alabama River.	"
248 Larkinsville.	"	138 Selma.	"
254 Scottsboro.	"	Columbus Branch.	
259 Bellefonte.	"	0 Columbus.	1 b. Huronian.
265 Fackler's.	"	4 Smith's or Dover	"
271 Stevenson.	{ 3 b. Quebec or Knox	6 Mott's Mill.	20. Quaternary.
	shale, with hills of	8 Salem.	"
	Sub-Carboniferous.	19 Hollis.	1 b. Huronian.
		25 Yonges. ¹⁷	"
		29 Opelika.	"

15. At Oxford, the railroad crosses through a gap of 2 b. Potsdam, and thence to Cross Plains the mountains of 3 b. Potsdam are on the east side. Beyond Cross Plains, to the State line, these mountains can be seen from the cars. E. A. S.

16. The railroad is built on 3 b. Quebec or Knox dolomite almost all the way from Montevallo to the State line, crossing 3 c. Chazy and 4 a. Trenton near Calera and the Coosa coal field above Calera. E. A. S.

17. Yongesborough narrow gauge railroad, 2½ miles to Chewackla Lime Company's kilns, southeast. The limestone of this company's quarries is a highly crystalline dolomite. W. G.

18. The hills on the west of the railroad consist principally of limonite, and their detritus constitutes the bright red banks of the cuts and fills for many miles. The Thomas ore bank is on east side, close to the main track, nearly opposite the station house. The hills seen beyond these belong to the Warrior coal field. W. G.

19. In addition to the 4 a. Trenton, there are within the limits of the city of Chattanooga the 3 a. Calceiferous, 4 b. Cincinnati, 5 Clinton, 10 a. Black shale, and 14. Carboniferous formations.

J. S. SAMPSON.

Mobile and Girard Railroad.			Alabama Central Railroad.		
Ms.			Ms.		
0	Columbus, Ga.	1 b. Huronian.	0	Selma.	18. Cretaceous.
9	Fort Mitchell.	18. Cretaceous.		Marion Junction	"
20	Seale.	"	23	Brown's.	"
25	Hatchechubbee.	"	30	Uniontown.	"
35	Hurtville.	"	35	Fawnsdale.	"
39	Guerryton.	"	42	Macon.	"
54	Union Springs.	"		Van Buren.	"
63	Thomas Station.	"	50	Demopolis.	"
72	Linwood.	"	66	Coatopa.	"
77	Jonesville.	"	81	York.	"
84	Troy.	19. Tertiary.		Cuba.	"
				Toomsaba.	"
			108	Meridian.	"
Mobile and Montgomery Railroad.			Montgomery and Eufaula Railroad.		
0	Montgomery.	18. Cretaceous.	0	Montgomery.	18. Cretaceous.
10	McGehee's.	"	10	Oak Grove.	"
16	Morgansville.	"	13	Perry's Mill.	"
21	Letohatchie.	"	16	Pike Road.	"
28	Calhoun.	"	21	Matthews'.	"
33	Fort Deposit.	"	25	Mitchell's.	"
44	Greenville.	19. Tertiary.	28	Fitzpatrick's.	"
53	Bolling.	"	33	Thompson's.	"
60	Georgiana.	"		Crossing of Mobile and Girard Railroad.	
67	Garland.	"	40	Union Springs.	18. Cretaceous.
	Madge's Mills.	"	50	ThreePath Road	"
76	Gravella.	"	54	Midway.	"
81	Evergreen.	"	62	Spring Hill.	"
86	Sparta.	"	66	Batesville.	"
91	Castleberry.	"	74	Cochran.	"
106	Brewton.	"			
114	Pollard.	"	81	Eufaula.	{ 18. Cretaceous, marl bluff of the Chatta- hoochie River.
119	Whiting or Pen	sacola Jun. 19. Tert'y.			
134	Williams.	"			
155	Bay Minette.	"			
163	Tensas River.	"			
178	Mobile.	"			
Selma and Gulf Railroad.			Selma, Marion and Memphis Railroad.		
0	Selma.	18. Cretaceous.		Selma.	18. Cretaceous.
	Pleasant Hill.	"	0	Marion Junction	"
	Snow Hill.	"	14	Marion.	"
35	Allenton.	"	21	Grove Cottage.	"
40	Pine Apple.	19. Tertiary.	29	Newbern.	"
	Cokerville.	"	37	Greensboro.	"
			45	Sawyersville.	"
Mobile and Alabama Grand Trunk R. R.			Savannah and Memphis Railroad.		
0	Mobile.	19. Tertiary.	0	Opelika.	1 b. Huronian.
9	Cleveland.	"	10	Gold Hill.	"
20	Cold Creek.	"	15	Waverly.	"
29	Mount Vernon.	"	22	Camp Hill.	"
39	Leona.	"		(Dudleyville gold mines).	
50	Sunflower.	"	30	Dadeville.	1 b. Huronian.
59	Jackson.	"	35	Jackson's Gap.	"
			40	Sturdevant.	"
			42	Salisbury.	"
			47	Alexander City.	"
			53	Kellyton.	"
			60	Goodwater.	Stealite (soapstone) qur.
Mobile and Ohio Railroad. (Part in Alabama.)			East Alabama and Cincinnati Railroad.		
0	Mobile.	19. Tertiary.	0	Opelika.	1 b. Huronian.
5	Whistler.	"	10	Oak Bowery.	"
18	Churchula.	"	23	Buffalo Wallow	"
33	Citronelle.	"			
44	Deer Park.	"			
51	Escatawpa.	"			
63	State Line.	"			
Vicksburg and Brunswick Railroad.			Vicksburg and Brunswick Railroad.		
0	Eufaula.	18. Cretaceous.	0	Eufaula.	18. Cretaceous.
5	White Oak.	"	5	White Oak.	"
25	Clayton.	"	25	Clayton.	"

Mississippi.

New Orleans, St. Louis and Chicago Railroad.		Ms. Mobile & Ohio Railroad—Continued.	
Ms.	road.		
88 Osyka.	19. Later Tertiary.	135 Meridian.	19 a. Tertiary Eocene.
98 Magnolia.	"	147 Lockhart.	"
108 Summit.	"	164 Narketa.	"
118 Bogue Chitto.	"	176 Scooba.	18. Cretaceous.
128 Brookhaven.	"	188 Shuqulak.	"
139 Beauregard.	"	198 Macon.	"
149 Hazlehurst.	"	211 Crawford.	"
158 Crystal Springs.	"	219 Artesia.	"
167 Terry.	"	232 West Point.	"
174 Byram.	"	241 Muldon.	"
183 Jackson.	19 a. Tertiary Eocene.	254 Egypt.	"
195 Madison.	"	262 Okolona.	"
206 Canton.	"	275 Verona.	"
220 Vaughans.	"	287 Saltillo.	"
234 Goodman.	"	297 Baldwin.	"
242 Durant.	"	309 Booneville.	"
251 West.	"	318 Rienzi.	"
262 Vaiden.	"	329 Corinth.	"
271 Winona.	"	New Orleans and Mobile Railroad.	
283 Duck Hill.	"	40 Grand Plain.	20. Quaternary or Alluvium.
295 Grenada.	"	52 Bay St. Louis.	"
310 Coffeeville.	"	64 Scott.	"
323 Water Valley.	"	71 Mississippi.	"
333 Taylor's.	"	80 Biloxi.	"
340 Oxford.	"	90 Belle Fontaine.	"
357 Abbeville.	"	100 East Pascagoula.	"
369 Holly Springs.	"	108 Murray.	"
378 Hudsonville.	"	Vicksburg and Meridian Railroad.	
382 Lamar.	"	0 Vicksburg.	20. Quaternary.
295 Grenada.	"	10 Bovina.	19 a. Tertiary Eocene.
Oakland.	"	18 Edwards.	"
Sardis.	"	27 Bolton.	"
Hernando.	"	35 Clinton.	"
Memphis.	"	45 Jackson.	"
Mobile and Ohio Railroad.		59 Brandon.	"
63 State Line.	19. Later Tertiary.	70 Pelahatchie.	"
71 Buckatunna.	"	79 Morton.	"
82 Waynesboro.	19 a. Tertiary Eocene.	90 Forest.	"
96 Shubuta.	"	100 Lake.	"
109 Quitman.	"	109 Newton.	"
120 Enterprise.	"	122 Chunky.	"
		140 Meridian.	"

Louisiana.*

GEOLOGICAL FORMATIONS OF LOUISIANA :

GENERAL TABLE.	LOUISIANA FORMATIONS.	GENERAL TABLE.	LOUISIANA FORMATIONS.
20. QUATERNARY.	20 c. Alluvium.	19. TERTIARY.	19 c. Grand Gulf.
“	20 b. Bluff.	“	19 b. Vicksburg.
“	20 a. Drift.	“	19 a. Jackson.
		18. CRETACEOUS.	18. Cretaceous.
Ms. Vicksburg, Shreveport & Texas R. R.		Ms. Morgan's Louisiana and Texas R. R.	
0 Delta.	20 c. Alluvium.	0 Algiers.	20 c. Alluvium.
10 California.	“	3 Gretna.	“
17 Tallulah.	“	12 Jefferson.	“
24 Quebec.	“	18 St. Charles.	“
35 Delhi.	20 b. Bluff.	24 Boutte.	“
47 Bee Bayou.	“	32 Des Allemands.	“
54 Girard.	“	40 Raceland.	“
64 Gordon.	20 c. Alluvium.	46 Ewings.	“
71 Monroe.	“	52 Lafourche.	“
		55 Terrebonne.	“
Texas and Pacific Railroad.		61 Chucahoula.	“
Marshall and Shreveport Division.		66 Tigerville.	“
0 Shreveport.	19 a. Jackson, Tertiary.	73 Bayou City.	“
8 Beckville.	“	80 Morgan City.	“
10 Greenwood.	“		
(Continued in Texas.)		New Orleans, St. Louis and Chicago R. R.	
New Orleans and Mobile Railroad.		0 New Orleans.	20 c. Alluvium.
0 New Orleans.	20 c. Alluvium.	10 Kenner.	“
9 Lee.	“	37 Manchac.	“
20 Chef Menteur.	“	52 Hammond.	20 b. Bluff.
31 Rigolet's.	“	60 Amite.	“
(Continued in Mississippi.)		74 Tangipahoa.	19 c. Grand Gulf, Tertiary.
		75 Osyka.	“
		(Continued in Mississippi.)	

* From Prof. F. V. Hopkins' (late State Geologist) map of his Geological Reconnaissance of Louisiana, and revised by him.

Arkansas.*

GENERAL GEOLOGY OF THE STATE.—Dividing the State diagonally from northeast to southwest, beginning near the eastern boundary of Randolph county and running thence past Grand Glaize and Little Rock, through to Fulton in Hempstead county on Red River, (consequently nearly in the line of the St. Louis, Iron Mountain and Southern Railroad), almost all the State, *east* of said line, will be found of the 19. Tertiary formation, except along the river bottoms, where it is 20. Quaternary. The northern portion, *west* of said line, is mostly 2-8. Silurian, with some 9-12. Devonian and 14. Carboniferous, further south; the middle western part of the State being 14. Carboniferous, while the southwest part (namely, from Arkadelphia and Murfreesboro south and west) will be found 18. Cretaceous.

In consequence of the above general arrangement of the geological formations in the State, it will be readily perceived that the St. Louis, Iron Mountain and Southern Railroad runs mainly near the junction between the Silurian, Carboniferous and Cretaceous of the west side, and the 19. Tertiary, with some 20. Quaternary, of the east side. Further, that the Arkansas Central is chiefly in the 19. Tertiary and 20. Quaternary, while the Little Rock and Fort Smith Railroad passes through the 14. Carboniferous formation; also, that the Memphis and Little Rock Railroad runs through 19. Tertiary and 20. Quaternary.

The expression, "Quaternary over Silurian," is intended to indicate that the superficial deposits of the locality, opposite which the remark is placed, are Quaternary; but that when lower formations are exposed by denudation, &c., they would be found Silurian. A similar interpretation is designed to be given to "Tertiary over Cretaceous," and the like expressions. R. O.

Ms. | Arkansas Central Railroad.

0 Helena.	20. Quat. over 19. Ter.
10 Bushville.	"
21 Marvell.	"
30 Palmer's.	"
40 Duncan.	"
48 Clarendon.	"

St. Louis, Iron Mountain and Southern R.R.

186 Moark.	20. Quat. over Silurian.
192 Corning.	"
203 Peach Orchard.	"
214 O'Kean.	"
225 Walnut Ridge.	"
232 Minturn.	"
244 Swifton.	"
262 Newport.	"
273 Grand Glaize.	14 a. Millstone Grit.
278 Bradford.	"
292 Judsonia.	"
305 Garner.	"
312 Beebe.	"
320 Austin.	"
332 Jacksonville.	"
345 Little Rock.	14. Carboniferous.
355 Mabelvale.	"
368 Benton.	"
388 Malvern.	"
410 Arkadelphia.	{ Junction of 14. Carb., 18. Creta. & 19. Ter.
437 Boughton.	19. Ter. over 18. Creta.
449 Emmet.	"
457 Hope.	"
471 Fulton.	"
490 Texarkana.	"

Ms. | Arkansas Central Railroad—Continued.

388 Malvern.	14. Carboniferous.
406 Lawrence.	"
413 Hot Springs.	"

Ms. | Little Rock and Fort Smith Railroad.

0 Argenta.	14. Carboniferous.
10 Warren.	"
30 Conway.	"
44 Plummerville.	"
63 Atkins.	"
75 Russellville.	"
83 Georgetown.	"
95 Cabin Creek.	"
101 Clarksville.	"
125 Ozark.	"
150 Alma.	"
159 Van Buren.	"
168 Cherokee.	"

Memphis and Little Rock Railroad.

0 Memphis.	20. Quat. over 19. Ter.
12 Riceville.	"
17 Edmondson's.	"
33 Black Fish Siding.	"
41 Madison.	19. Tertiary.
53 Palestine.	"
65 Wheatley.	"
70 Brinkley.	"
87 De Vall's Bluff.	19. Ter. over Mills. Grit.
94 Hazen's.	"
103 Carlisle.	"
112 Lonoke.	"
125 Galloway.	"
135 Little Rock.	14. Carboniferous.

* Prepared by Prof. Richard Owen, of Bloomington, Indiana.

Texas.

International and Great Northern Railroad.		Ms. Texas and Pacific Railroad—Continued.	
Ms.			
Galveston.	20. Quat. or Alluvium.	116 Manthis.	19. Tertiary.
0 Houston.	"	143 Minneola.	"
23 Spring.	19. Tertiary.	157 Grand Saline.	"
47 Willis.	"	174 Wills Point.	"
66 Phelps.	"	190 Terrell.	"
85 Trinity.	"	209 Mesquite.	"
99 Lovelady.	"	222 Dallas.	"
114 Crockett.	"	241 Arlington.	"
127 Grapeland.	"	254 Fort Worth.	"
139 Elkhart.	"	Houston and Texas Central Railroad.	
152 Palestine.	"	0 Houston.	19. Tertiary.
164 Neches.	"	18 Thompson.	"
180 Jacksonville.	"	35 Hockley.	"
198 Troupe.	"	50 Hempstead.	"
211 Overton.	"	70 Navasota.	"
223 Kilgore.	"	99 Bryan.	"
235 Longview.	"	120 Hearne.	18. Cretaceous.
259 Marshall.	"	142 Bremond.	"
275 Jefferson.	"	161 Thornton.	"
334 Texarkana.	18. Cretaceous.	181 Mexia.	"
Austin.	"	211 Corsicana.	"
0 Duval.	"	239 Palmer.	"
16 Hutto.	19. Tertiary.	265 Dallas.	"
50 Rockdale.	"	296 McKinney.	"
80 Hearne.	"	329 Sherman.	"
94 Englewood.	"	338 Denison.	14. Carboniferous ?
114 Marquez.	"	Western Division.	
125 Jewett.	"	0 Hempstead.	19. Tertiary.
152 Oakwoods.	"	21 Brenham.	"
169 Palestine.	"	46 Ledbetter.	"
0 Troupe.	"	78 MacDade.	"
19 Tyler.	18. Cretaceous.	115 Austin.	18. Cretaceous.
44 Mineola.	"	Waco Branch.	
Columbia Division.		0 Bremond.	18. Cretaceous.
0 Columbia.	20. Quaternary.	45 Waco.	"
18 China Grove.	"	Galveston, Harrisburg & San Antonio R. R.	
30 Houston.	"	0 Harrisburg.	20. Quaternary.
Texas and Pacific Railroad.		21 Stafford.	18. Tertiary.
Trans-Continental Division.		33 Richmond.	"
0 Texarkana.	18. Cretaceous.	52 East Bernard.	"
17 Whaley.	"	68 Eagle Lake.	"
34 De Kalb.	"	84 Columbus.	"
52 Walkers.	"	109 Schulenburg.	"
67 Begwell's.	"	146 Harwood.	"
90 Paris.	"	166 Kingsbury.	"
111 Honey Grove.	"	176 Seguin.	"
138 Savoy.	"	181 Marion.	"
154 Sherman.	"	Gulf, Western Texas and Pacific Railroad.	
Jefferson and Southern Division.		0 Indianola.	
0 Texarkana.	18. Cretaceous.	25 Placedo.	
16 Sulphur.	19. Tertiary.	55 Thomaston.	
44 Kildare.	"	70 Cuero.	
74 Marshall.	"		
98 Longview.	"		

Indian Territory.

Ms. Missouri, Kansas and Texas Railroad.		Missouri, Kansas and Texas Railroad— <i>Continued.</i>	
355 Vinita.	14 b. Coal Measures.	556 Durant.	14 b. Coal Measures.
379 Pryor Creek.	"	568 Colbert.	"
388 Choteau.	"	576 Denison.	"
410 Gibson.	"	Atlantic and Pacific Railroad.	
419 Muskogee.	"		
449 Eufala.	"	337 Shawnee.	14 b. Coal Measures.
470 Reams.	"	342 Prairie City.	"
479 McAllister.	"	348 Oseuma.	"
491 Savanna.	"	353 Afton.	"
506 Limestone Gap.	"	358 Albia.	"
525 Atoka.	"	364 Vinita.	"
536 Caney.	"		
544 Caddo.	"		

Florida.

Jacksonville, Pensacola and Mobile Rail- road.		Ms. Atlantic and Gulf Railroad.	
0 Chattahoochee.	20. Quat'y or Alluvium.	Jasper.	20. Quat'y or Alluvium.
11 Mt. Pleasant.	"	Live Oak.	"
20 Quincy.	"	Atlantic, Gulf and West India Transit Com- pany's Railroad.	
32 Midway.	"		
44 Tallahassee.	"	0 Fernandina.	20. Quat'y or Alluvium.
56 Chaires'.	"	12 Hart's Road.	"
62 Lloyd's.	"	27 Callahan.	"
71 Drifton.	"	36 Dutton.	"
78 Aucilla.	"	47 Baldwin.	"
85 Greenville.	19. Later Tertiary.	62 Trail Ridge.	"
99 Madison.	"	73 Starke.	"
114 Ellaville.	20. Quat'y or Alluvium.	84 Waldo.	"
127 Live Oak.	"	98 Gainesville.	"
138 Welborn.	"	104 Arredondo.	"
150 Lake City.	"	113 Archer.	"
162 Olustee.	"	122 Bronson.	"
172 Sanderson.	"	134 Otter Creek.	"
181 Darbyville.	"	145 Rosewood.	"
190 Baldwin.	"	155 Cedar Key.	"
198 White House.	"		
206 Jacksonville.	"		
0 Tallahassee.	"		
21 St. Marks.	"		
0 Drifton.	"		
4 Monticello.	"		

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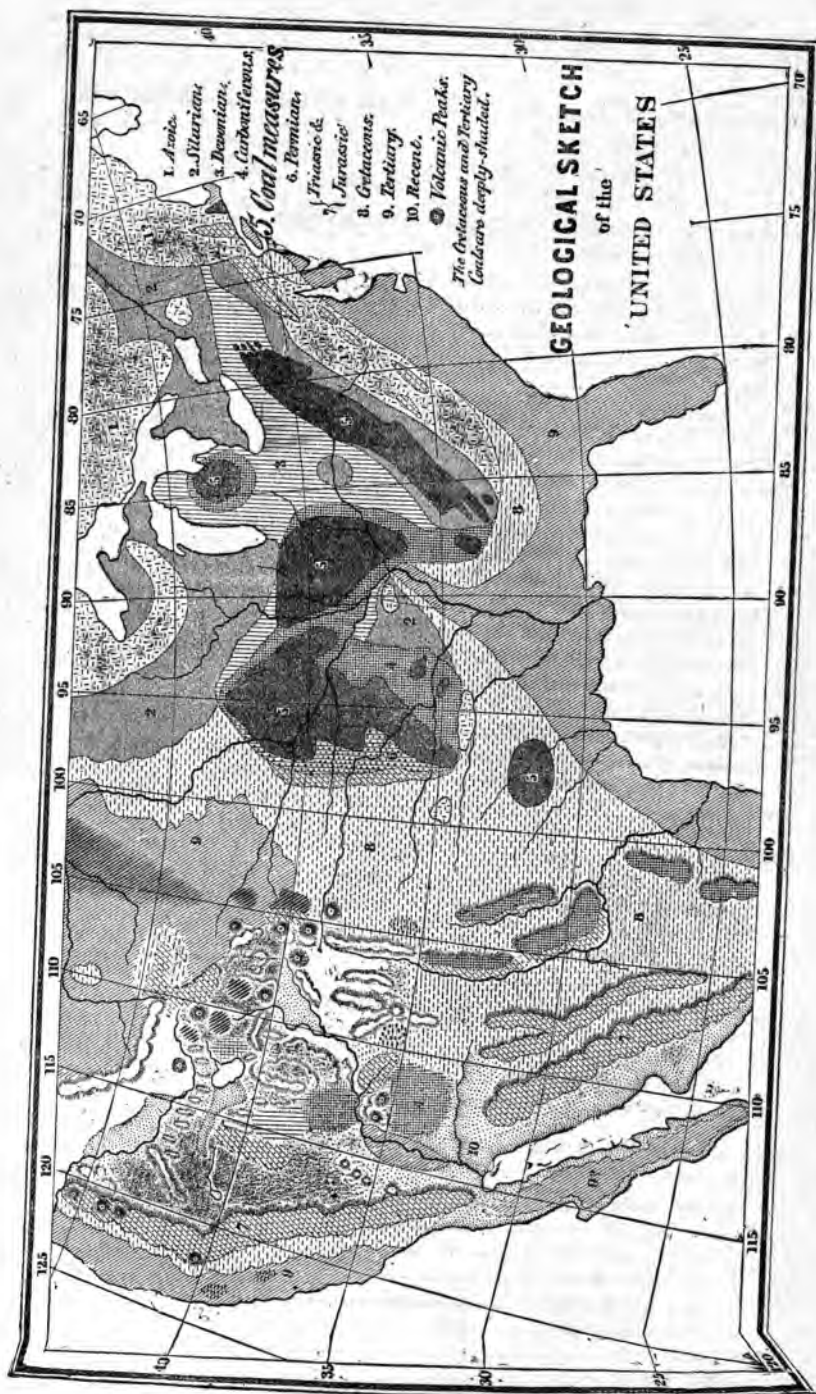
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CHRONOLOGY OF SOME OF THE OLDER IMPORTANT RAILROADS.

The several parts of what is now the NEW YORK CENTRAL AND HUDSON RIVER RAILROAD were completed at the following dates:

Albany to Schenectady	1831,	17 miles.
Schenectady to Utica	1836,	73 "
Buffalo to Niagara Falls.....	1837,	22 "
Rochester to Attica (Tonawanda Railroad).....	1837,	42 "
Utica to Syracuse.....	1839,	58 "
Syracuse to Auburn (twenty-two miles in 1838).....	1839,	26 "
Auburn to Rochester.....	August, 1841,	78 "
Buffalo to Attica.....	December, 1842,	32 "
<i>Line completed, Albany to Buffalo (gap of one mile filled).....</i>	1845.	
Schenectady to Troy.....	1842,	21 "
Troy to Greenbush.....	1845,	6 "
Batavia to Niagara Falls (afterward taken up).....	July 1, 1853,	36 "
Batavia to Buffalo (direct road).....	1850,	69 "
Niagara Falls to Suspension Bridge	April 1, 1854,	8 "
Suspension Bridge to Lewiston.....	1854,	6 "
Rochester to Syracuse (direct road).....	1853,	81 "
Rochester to Lockport and Suspension Bridge	July 1, 1852,	75 "
Buffalo to Lockport.....	1854,	26 "
Canandaigua to Batavia	January 1, 1853,	50 "
Schenectady to Athens (Athens branch).....	1865,	41 "
New York Central Railroad, Albany to Buffalo (18 corporations) consolidated.....	May 1, 1853.	

Hudson River Railroad:

New York to Peekskill.....	September 29, 1849,	41 miles.
Peekskill to New Hamburg	December 6, 1849,	28 "
New Hamburg to Poughkeepsie	December 31, 1849,	9 "
East Albany to Hudson	June 16, 1851,	23 "
Hudson to Oakhill.....	July 7, 1851,	6 "
Oakhill to Tivoli.....	August 4, 1851,	10 "
Tivoli to Poughkeepsie.....	October 8, 1851,	25 "
<i>Line, New York to East Albany (and to Buffalo), completed.....</i>	October 8, 1851,	142 "
New York Central and Hudson River Railroads consolidated....	November 1, 1869.	
New York and Harlem Railroad completed.....	January 19, 1852,	127 "

The several sections of the ERIE RAILWAY (now the New York, Lake Erie and Western) were opened at the following dates:

Piermont to Goshen.....	September, 1841,	46 miles.
Goshen to Middletown.....	June 7, 1843,	7 "
Middletown to Otisville.....	November 8, 1846,	8 "
Otisville to Port Jervis.....	January 6, 1848,	13 "
Port Jervis to Binghamton.....	December 28, 1848,	127 "
Binghamton to Owego.....	June 1, 1849,	23 "
Owego to Elmira.....	October, 1849,	87 "
Elmira to Corning.....	January 1, 1850,	17 "

CHRONOLOGY OF SOME OF THE OLDER IMPORTANT RAILROADS—(*Continued*).

Corning to Hornellsville.....	September 3, 1850,	41 miles.
Hornellsville to Dunkirk.....	April 22, 1851,	128 "
<i>Whole line opened</i>	April 22, 1851,	446 "
Hornellsville to Buffalo.....	1852,	92 "
Newburg branch.....	1850,	18 "
Corning to Avon (August 2, 1852, to Wayland).....	1853,	76 "
Avon to Rochester.....	August, 1854,	19 "
Avon to Mt. Morris.....	June, 1859,	16 "
Avon to Le Roy.....	1853,	14 "
Le Roy to Batavia.....	1854,	10 "
Attica to Batavia.....	June 20, 1853,	11 "
Ithaca to Owego (now Delaware, Lackawanna and Western).....	April 1, 1854,	83 "
Elmira to Watkins (now Northern Central Railroad).....	December 16, 1849,	17 "
Watkins to Canandaigua (now Northern Central Railroad).....	September 15, 1851,	47 "
Corning to Blossburg.....	1840,	41 "

BALTIMORE AND OHIO RAILROAD:

Baltimore to Ellicott's Mills (the first passenger railroad in the United States),	1890.
Baltimore to Washington.....	August 25, 1835.
Baltimore to Harper's Ferry.....	1834.
Baltimore to Cumberland.....	1842.
Baltimore to Wheeling.....	1853.
Baltimore to Parkersburg.....	May 1, 1857.

PENNSYLVANIA RAILROAD:

Philadelphia to Columbia (by the State of Pennsylvania).....	1834.
Allegheny Mountain Portage Railroad.....	1834.
Philadelphia to Pittsburg by Pennsylvania Railroad and the State Portage Railroad.....	December 10, 1852.
Philadelphia to Pittsburg, by Pennsylvania Railroad, completed..	February 15, 1854.

BOSTON AND ALBANY RAILROAD:

Boston to Worcester.....	July 4, 1835.
Worcester to Albany.....	December 21, 1841.

BOSTON, MASS., TO OGDENSBURG, NEW YORK..... 1851.

CENTRAL RAILROAD OF NEW JERSEY (Easton to New York)..... 1852.

LAKE SHORE AND MICHIGAN SOUTHERN RAILROAD:

Toledo to Chicago.....	March 22, 1852.
Buffalo to Pennsylvania Line.....	February 22, 1852.

CHICAGO, BURLINGTON AND QUINCY..... 1854.

CHICAGO, ROCK ISLAND AND PACIFIC..... 1854.

ILLINOIS CENTRAL (Main line)..... December 23, 1855.

OHIO AND MISSISSIPPI (Cincinnati to St. Louis)..... 1860.

CHICAGO AND NORTH-WESTERN to the Mississippi River at Fulton..... July 3, 1862.

UNION PACIFIC RAILROAD AND CENTRAL PACIFIC RAILROAD:

Omaha to San Francisco..... May 10, 1869.

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A NEW SUMMER-RESORT.

GREEN LAKE, *Five Miles South of Syracuse, New York, and One Mile West of Jamesville on the Delaware, Lackawanna and Western Railroad.*

A Magnificent Exposure of the Upper Helderberg Limestone. Extraordinary Geological Phenomena. Grand and Beautiful Scenery.

THERE are very remarkable precipices of Onondaga and Corniferous limestone, or the Upper Helderberg group, surrounding Green Lake, quite near the old stage-road leading from Albany to Buffalo. It is a pleasant walk of one mile, by a dry turnpike from Jamesville station; or it can be reached by a short drive from Syracuse, either *via* Brighton, the shortest road, or by Onondaga Valley, or by the Jamesville turnpike—all of them excellent roads with fine scenery.

On approaching the lake from the turnpike on the south side, the tourist is startled at finding himself, without any notice, on the brink of a yawning gulf, precisely like that of the Niagara River below the Falls, and nearly as deep. The rocks form perpendicular precipices of greater height and extent here, and in this vicinity, than in any other locality of this formation in the United States; and they present many features of the highest interest to the geologist, and to all who enjoy a scene of beauty and grandeur.

The brink of the chasm has been fringed by Nature, as no art could have done it, with arbor vitæ (*Thuja occidentalis*, L.) and cedars (*Cupressus thyoides*, L.), growing in the crevices of the limestones, and between these may be obtained beautiful glimpses of the lake, the rocks, and the gorge; and at many points, on the projecting table rocks, are full views of one of the most surprising and picturesque landscapes in this part of the country. It can be best described by imagining that a circular mass of the limestones, a quarter of a mile in diameter, had suddenly sunk into the bowels of the earth, thus forming a chasm on the flat top of the Helderberg range, three hundred feet deep, with very high, perpendicular walls of hard limestone, extending nearly all around the depression. A circular lake of greenish-colored, pure water, of unknown depth, covering about ten acres, fills the whole of the interior. The scene at even a first view is very fine, and is so out of the usual way as greatly to surprise the beholder and leave a lasting impression on his memory. It is not a ravine or cañon; there is no stream of water whatever, and no place where one could ever have existed, and the lake, which glistens deep down in the gulf, has no visible outlet, the bottom of the gap being above the level of the water, which probably finds its outlet through crevices in the underlying limestones.

But the interest is increased when we have passed around the lake and seen the other depressions with which it is surrounded, and studied their meaning and history, or the method of their formation. First go eastward, toward the only gap in the rocky walls, or the place where the outlet of the lake should be, if it had one. The upper surface of the Onondaga limestone is extensively exposed, forming a flat pavement on the south and north sides of the lake, extending to the brink of the precipice. The natural joints of the rock are greatly enlarged, forming wide crevices and round holes extending down into the solid rock, every edge and corner being thoroughly rounded and water-worn, in an extraordinary manner, as it could only have been done by the dashing shore-

waves of an ancient sea of which this was the coast. Through the openings in the thicket of beautiful young cedars, you get new views of the amphitheatre, and of its perfectly circular form. The cliff maintains its height until, at the gap, you find yourself on a lofty pinnacle of rock, overlooking the narrow pass, like a sentinel-tower placed to guard the entrance from all intruders. But on glancing to your right, or to the eastward, you find you are on a narrow point of rock, scarcely ten feet in width, with a deep gulf in front and one on either hand. On tracing the eastern margin of this elevated wall of rock, for it is little more, and which we will call Sentinel Point, you find it is a long, very narrow rib of rock, separating Green Lake from another, similar circular depression east of it, in which at present there is no water, but which fills up and overflows in the spring of the year. Nothing can exceed the steepness of the slope or rather precipice, and the forest is too dense and dark to see its bottom or extent. The young and vigorous may explore it; but the most impressive views are from above, and these may all be seen without laborious walking.

Returning past your first point of observation, you now go to the western part of the circular gorge. All around three-fourths of this principal cavity is the same perpendicular precipice of the upper and harder limestone; and even that of the Water Lime group below, extending to the water, although covered with trees, has a very precipitous slope. The lake itself is absolutely inaccessible without a staircase of two hundred steps at the lowest point of the rocks, except at its natural gap on the east side, where a gateway would convert it into a prison or Botany Bay. It was the weight, strength and toughness of the Onondaga Limestone, that have preserved it, to become the huge cornice of this roofless temple. Here at the west, just as at the south and north sides, the horizontal strata forming the chasm are unbroken; but there is only a narrow neck of rock, of an irregular form, about sixty feet wide, west of which is a third depression similar to that of Green Lake, also forming a circle, but smaller in size and easy of access, with the Water Lime group exposed at the bottom. It has no water in it, but is covered with pasturage and young cedars. On the west side, the Corniferous limestone rises to a great height, forming the loftiest part of the tract. The rocks are less abrupt than around Green Lake, in fact forming slopes and terraces. The Coliseum of Rome could here be reconstructed, the sloping, rocky walls forming the seats for the audience, and much of it is quite as high as the walls of the original Coliseum, which were 162 feet. The interior, where the bottom fell out, represents the arena. The regular basin-like manner in which the rock has been broken off in a circular form, and sunk directly downward, is quite apparent; and, as the periphery is perfect, it seems impossible that the material could have been carried away by running water, as it has no gap or outlet, as the parent Green Lake has. It requires no practical or theoretical knowledge of geology to contrast the worn and rounded appearance of the extensive bare pavement, both on the south and north sides of the lake, which was evidently eaten away by the angry waves of an ancient ocean, with the sharp and quarry-like edges of all the rocks exposed in all of these great depressions. The high slender headland of Sentinel Point could not have stood a week exposed to such a sea. The proof is strong that *the depressions were not worn out by water, either of a river or of an ocean, or by glacial action, but by the sinking of the material, the broken fragments of*

which were engulfed beneath the waters of the lake, and in the dark depths of the other depressions.

If you now pass around to the north side of the principal chasm or Green Lake, you will find the walls of rock are considerably higher than on the south side, the elevation imparting grandeur to the scene. But, as you go eastward over the limestone pavement, honeycombed into large, open joints, and with its curious, round, water-worn holes, you will find yourself again, not, as you expected, on a wide, level plateau extending northward, but on another high, narrow wall similar to Sentinel Point; but this is a mole, not a promontory, and extends around this side of the lake nearly to the gap, separating the valley of Green Lake from two others of these remarkable deep depressions lying immediately north of it. They are very large, deep, dark, crater-like sink-holes, covered with heavy timber. Days might be spent in exploring the precipices and gorges in these cool forests. It is less than a quarter of a mile northward to the fine precipices which overlook the Delaware, Lackawanna and Western or Syracuse and Binghamton Railway, between Jamesville and Syracuse, affording magnificent views of Butternut Creek Valley. There is here also a very curious cave, of considerable extent, caused by the front of the cliff sinking, owing to its foundation giving way, and separating a great mass or pillar of the rock from the main body, producing a very deep fissure. It is an unfinished avalanche. Broken pieces of the upper part of the rock afterward fell into the opening, arching it over. There is a similar and larger cave farther west.

The most probable explanation of the general structure of this whole locality is, that all these depressions are sink-holes, and that their subsidence was caused by the former existence in the underlying Onondaga Salt group, beneath these limestones, of large beds of rock-salt—the most soluble of rocks—which were destroyed by underground solution, and that these singular depressions, Green Lake and those that surround it, and probably other important features in Central New York, have been caused by the consequent subsidence of the strata. The ancient sea, which has eaten out the surface of the overlying Onondaga limestone pavement, as above described, furnished the dissolving power, wearing great cavities in the salt-beds. With such an exposure, their destruction was inevitable. The solution was irregular, and the sinking corresponds to it—the narrow ribs of rock between the depressions being sustained either by similar ribs of salt saved from destruction, or, as is more probable, by the broken materials which fell into the cavities in such a way as to sustain the circumference of the pits. Their form indicates some unusual origin, and, accepting the explanation or theory of their formation, it appeals to the imaginative powers to fancy when the cataclysm occurred, and what were the sights and sounds that attended it, which there was no eye to see and no ear to hear. It is true that no rock-salt has ever been found in Onondaga County, salt being here extensively manufactured from brine, the source of which is only a matter of conjecture; but no search has ever been made for it under the limestone, where alone it could be protected. A bed of rock-salt, seventy feet thick, was found in June, 1878, at Wyoming, New York, thirty-seven miles southwest of Rochester, in a deep boring penetrating through the overlying formations into the Onondaga salt-group; and at Goderich, in Western Canada, beds of rock-salt from seventy to one hundred and twenty-six feet in thickness have been dis-

covered in this same formation. Green Lake is situated where the Salina or Onondaga salt-group is much thicker than it is farther west. This being the central and deepest part of the ancient inland sea, the evaporation of whose waters left the deposit of salt, it is but fair to infer that the salt-beds were here at their maximum thickness. In other parts of the world there are beds of salt measuring thousands of feet in thickness.

A practical conclusion is that the salt-beds should not be searched for where there is evidence of subsidence having taken place, but only in districts where the strata have never been disturbed.

Whatever explanation Science may ultimately give of the formation of Green Lake, it requires no scientific knowledge to see that it is a very remarkable, interesting, and beautiful place in a state of Nature; and that, with but slight improvement, it would deserve to rank with the best of American summer-resorts. The property has been lately purchased by James Macfarlane, Esq., of Towanda, Pennsylvania, the geologist, and he will soon cause it to be prepared for visitors in 1879, and such improvements to be made as the public patronage may warrant. To the neighboring city of Syracuse, five hundred feet below it, and all Central New York, it will supply what may be called a public want, as there is nothing in the vicinity to be compared with Green Lake.

September 2, 1878.



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The geologist's traveling hand

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